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Donald F. Haggard, Norman Willard, Jr., Robert A. Baker, William C. Osborn, and Shepard Schwartz

HumRRO Division No. 2

June 1970

Prepared for:

Office, Chief of Research and Development
Department of the Army

Contract DAHC 19 70 C 0012

HumRRO

HUMAN RESOURCES RESEARCH ORGANIZATION

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300 North Washington Street • Alexandria, Virginia 22314

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HumRRO Division No. 2
Fort Knox, Kentucky
HUMAN RESOURCES RESEARCH ORGANIZATION

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Work Unit TRAINMAN

FOREWORD

The purpose of Work Unit TRAINMAN was to develop a course of instruction in the systems engineering approach to Army training program development that would be beneficial to officers in their roles as managers of training. Fulfilling this purpose required translating training technology into a course of instruction, estimating the course value to Army officers, and matching course content to the technical background of the potential military student and instructor.

This report describes the developmental activities of Work Unit TRAINMAN and includes the course materials developed. It contains prototype lesson outlines and supporting literature for the course. It also suggests the activities necessary to implement the course within the Army officer training system.

The project was undertaken by HumRRO at the request of the U.S. Army Armor School. The research was performed and most of the report preparation completed while HumRRO was part of The George Washington University.

Research was conducted by HumRRO Division No. 2, Fort Knox, Kentucky. The project was initiated and conducted under the supervision of Dr. Norman Willard, Jr., Director of Research, and completed under the supervision of Dr. Donald F. Haggard, the present Director. Support was provided by the U.S. Army Armor Human Research Unit; COL Charles H. Brown was Chief of the Unit during the early phases of the project, LTC William Q. Harty during its conduct, and LTC John A. Hutchins, Jr., during its completion.

Permission has been obtained for the use of copyrighted materials included in this report.

HumRRO research for the Department of the Army is conducted under Army Contract DAHC 19-70-C-0012. Training, Motivation, Leadership Research is conducted under Army Project 2Q062107A712.

Meredith P. Crawford
President
Human Resources Research Organization

The Human Resources Research Organization (HumRRO) is a nonprofit corporation established in 1969 to conduct research in the field of training and education. It is a continuation of The George Washington University Human Resources Research Office. HumRRO's general purpose is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation. HumRRO's mission in work performed under contract with the Department of the Army is to conduct research in the fields of training, motivation, and leadership.

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MILITARY PROBLEM

The need for efficient management of formalized training in the Army is becoming increasingly critical as jobs become more technical and as new training knowledge and methods are developed. It is essential for efficient management that training personnel become familiar with the technology of training and with the techniques for managing training, because the Army administers hundreds of training programs and because there are frequent demands for introducing new courses, or for updating existing courses. However, relatively little instruction is now being provided in most aspects of training technology or training management and the bases for providing such instruction are not readily available.

RESEARCH PROBLEM

The system engineering approach—which can be considered a special case of value engineering—to training program development has been formulated and applied successfully to a wide variety of training problems. However, the management functions of this approach have been only grossly delineated and have seldom appeared as a comprehensive system. Similarly the training facts and principles that comprise a technology of training are documented in a wide variety of publications and have been only slightly related to management functions. Thus, the extent to which both technology and management functions are available and utilizable for the development of training programs is uncertain.

The primary purpose of this study was to organize the facts and facets of the present technology of training and the systems development of training to provide a consistent and useful sequence of instruction for management functions required for training. Fulfilling this purpose depended on the degree of success in meeting three objectives: (a) determining whether the status of the technology of training is sufficiently systematized to be translated into a course of instruction, (b) estimating the value of such a course to Army officers, and (c) matching course content to the technical background of the potential military student and instructor.

APPROACH

The development of the course of instruction consisted of four phases. During Phase 1, HumRRO developed a preliminary course of instruction based on a survey of job requirements of training-relevant duty assignments of graduates of the Armor Officer Advanced Course, the HumRRO systems approach to training analysis, and the relevant available literature and HumRRO experience in the technology for designing effective instructional systems. HumRRO critique of the resulting course outline and materials indicated that the course was sufficiently systematized to provide a coherent sequence of management functions for training.

In Phase 2, the preliminary course was conducted by HumRRO as an elective for the Armor Officer Advanced Course at Fort Knox. A tentative evaluation was made on the basis of discussions with selected students and an end-of-course critique written by each student. On the basis of this evaluation, HumRRO personnel modified the course.

During Phase 3, HumRRO conducted the modified course as an elective for two Advanced course classes with Army instructors as observers.

In Phase 4—the basis of student appraisal—the military instructors assumed responsibility for conducting the course. An Army instructor presented the course as an elective for two Advanced Course classes.

RESULTS AND PRODUCTS

Phase 1. A course outline and materials providing a coherent sequence of management functions for training were produced.

Phase 2. A tentative evaluation by students in the first administration of the course indicated that it had considerable potential value. However, (a) the students did not have a basic and functional knowledge of the systems concept, training system engineering, and the Army training organization; (b) the content of the course was not entirely consistent and the transition between instructional units was poor; (c) instructional techniques needed improvement.

The course was modified to emphasize the discussion method and provide more examples of military application of the techniques described in the reading assignments. Demonstrations of techniques-in-action in the Armor School were added, along with introductory material to provide a background in the Army organization for training functions. Lectures were printed to be used as preparatory readings.

Phase 3. The modified course consists of a set of lesson outlines for a 96-hour course, a selected set of supporting references, and the texts of a set of supporting readings (these materials are appended to the report).

At the completion of the second presentation, a questionnaire evaluation completed by the students indicated that the course was of substantial value in increasing understanding of Army training and the techniques that effective training requires.

Phase 4. The administration of the course by an Army instructor for two Advanced Course classes was not evaluated directly, but was favorably received and resulted in further suggestions for making the course more effective.

CONCLUSIONS

Overall the products of the study appear to have met the objectives that were set for it: A course in the management of training was constructed, it was judged to be of substantial value by the AOAC students enrolled in it, and it was taught successfully by a military instructor. Both students and instructors suggested additional revision of the course before its adoption by the Army. The suggested revisions are:

(1) Reducing the course length to approximately 30 hours.

(2) Integrating the course more specifically with the CONARC Regulation 350-100-1, *Systems Engineering of Training*, dated 1 February 1968.

(3) Coordinating course materials more closely with course objectives.

(4) Presenting the revised course as a "progressive" career-sequence of courses to be provided over an officer's Army career.

These revisions would not require further research and development and could be accomplished by military operational training personnel with technical assistance by research personnel

CONTENTS

An Experimental Program of Instruction on the Management of Training

INTRODUCTION

The need for efficient management of formalized training in the Army is becoming increasingly critical as jobs become more technical and as new training knowledge and methods are developed. The tremendous size of the Army's training operation makes the need for efficiency imperative. As Assistant Secretary of Defense for Manpower, Thomas D. Morris estimated[1] that of the four million military and civilian personnel employed by the Department of Defense, 400,000 could be found in a formal training environment at any time during the year. Furthermore, four of every 10 defense employees receive some formal training each year. For example, during a one-month period 90,000 men were in training on any weekday, and for every four individuals being trained there was one trainer or training support individual at work. Most impressive of all was the fact that the annual training bill was over four billion dollars. Obviously, management of training is of critical importance in such a large and complex training enterprise.

In February 1966 a Department of the Army Board (Haines Board), established to review Army officer schools, recommended that career courses be modified to include material that would have immediate utility. Specifically, it recommended that the Officer Advanced Courses be designed to prepare those taking them for command and staff duties at Battalion through Brigade, or comparable levels, with emphasis on command at Battalion level, and for duty as Assistant Division General Staff Officers. A second recommendation involved both broadening and improving training in the managerial functions that such duty assignments entail

In implementing the Haines Board recommendations, service schools soon recognized the need for increasing the amount of material devoted to training management. Because of their combat arms orientation, the greatest number of Advanced Course graduates would, during the following five years, be assigned to S3 or G3 positions, become instructional supervisors within the U.S. Continental Army Command (CONARC) training system, or be assigned to planning and analysis positions in the boards of the U.S. Army Materiel Command or the agencies of the U.S. Army Combat Developments Command. Each of these assignments was considered training relevant, since they influence the necessary inputs to training program development or to the operation of programs in process.

Accordingly, many in the schools felt that there was relatively little instruction in most aspects of training management. Thus the U.S. Army Armor School, in initiating the development of an Electives Program for the Armor Officer Advanced Course, considered the inclusion of instruction in training management functions. The Electives Program was being developed to supplement the core curriculum of the Advanced Course. The program objective was to better prepare the graduate for future assignments by enlarging his opportunity for allied intellectual and professional development. The Haines Board had recommended that management training be provided in functional areas and that it be oriented so as to cover specific Army problems. The management of training was obviously a functional area that was becoming recognized more and more as an Army problem.

[1] T.D. Morris, "Engineering Systems for Education and Training Through DoD-Industry Collaboration," paper for Engineering Systems for Education and Training Conference, Washington, June 1966

However, the bases for providing instruction in training management were not readily available. Most of the available Army materials were concerned with the administration of instruction (e.g., techniques for presenting instruction, scheduling personnel, allocating facilities and supplies). The techniques of management, as they pertain to the development and cost/effective maintenance of job-performance oriented training programs, had not been similarly organized.

The Armor School requested that HumRRO attempt to organize the existing concepts, ideas, and guidelines that had been developed so as to formulate an exploratory course of instruction in the management of training.[2] The course was to be included in the pilot Electives Program of the School for Fiscal Year 1967 and was to be evaluated in terms of its applicability to the Armor Officer Advanced Course curriculum for future years.

OBJECTIVES

The utility of a system engineering approach—which can be considered a special case of *value engineering*[3]—in the development of training programs for a wide variety of military tasks has been repeatedly demonstrated. The approach has resulted in reductions of training time and costs and in improvements of student achievement. During this period, training research has steadily added to the technology of training. With the hundreds of training programs operated by the Army and with the frequent demands for new courses, or for updating existing courses, it is important that training personnel be familiar with the technology of training and with the techniques for managing training.

It was not known, however, to what extent the present training technology could be organized to form a systematized body of knowledge for instruction in the management of training. Facts and principles have been documented in a wide variety of publications but concise methodology for tying this information together is not available. In the same manner, management functions have often been only grossly delineated and have seldom, if ever, appeared as a comprehensive system. To what extent both technology and management functions are available, or utilizable, outside the mind of the practitioner, or artisan, of training development is uncertain.

The primary purpose of this study was to organize the facts and facets of the present technology of training and the systems development of training into an instructional program beneficial to Army officers in their roles as training managers. Fulfilling this purpose depended on the degree of success in meeting three objectives: (a) determining whether the present state-of-the-art in training is sufficiently systematized to be translated into a course of instruction; (b) estimating the value of such a course to Army officers; (c) producing a course that is sufficiently clear in technical content to match the technical background of the student, as well as that of the potential military instructor in the course.

This study did *not* propose adaptation to a final form of the course that could be adopted by the Department of the Army for application throughout the Army system. But it was anticipated that the finalized course, if it were successful, could be submitted to Department of the Army for consideration for Army-wide adoption.

[2] Letter, 6 June 1966, U.S. Army Armor School AHBAAS-GS, to U.S. Army Armor Human Research Unit, Fort Knox, subject: Exploratory Development in the Area of Training Management Instruction.

[3] Achieving a function (not necessarily mathematical) at the lowest sound cost—a general and abstract form of cost effectiveness.

APPROACH

HumRRO development of the course of instruction was to consist of formulation, implementation, and presentation of a resident program on a one-time basis as part of the Armor Officer Advanced Course Electives Program for Fiscal Year 1967. This initial approach was later revised as follows: The course was to be developed in four phases (Table 1). During Phase 1, course plans and materials would be formulated and constructed by the HumRRO staff. If it appeared that the course had sufficient substance, the HumRRO staff would conduct it as Phase 2 and then review and revise it as necessary. During Phase 3, Army instructors, with HumRRO assistance, would conduct the modified course (actually, because of Army instructor turnover, Phase 3 was conducted by HumRRO and monitored by Army instructors). For Phase 4, the course would be conducted and finalized entirely by military instructors.

Table 1

Study Schedule

Phase	Activity	Time
1	HumRRO Construction	2d and 3d Qtrs, FY 67
2	HumRRO Presentation	3d and 4th Qtrs, FY 67
3	Army (HumRRO) Presentation	1st and 2d Qtrs, FY 68
4	Army Presentation	3d and 4th Qtrs, FY 68

Phase 1: HumRRO Program Construction

Three sources of information and guidance provided the bases for course construction: (a) the job requirements for training-relevant duty assignments of graduates of the Armor Officer Advanced Course; (b) the procedure that had been developed by HumRRO for training system analysis;[4] (c) available literature and HumRRO experience pertaining to the technology for designing effective instructional systems.

Because of the limited time between approval of the activity by the Office of the Chief, Research and Development, and the requested date for initiation of the instruction, a thorough job analysis and derivation of training objectives was not feasible. Rather, a survey was conducted of the training-relevant duties that had been performed by Advanced Course graduates (lieutenant-colonels and colonels) stationed at Fort Knox. These duties were tabulated by job assignment. The results of the survey[5] were used as the functional basis for the course.

General units of instruction for the course were specified from the seven-step training systems approach to course design that had been developed by HumRRO.[6] The systems concept was elaborated in sufficient detail to provide understanding of the Army as a system and training as an interacting subsystem within the Army. Other interacting human factors subsystems, such as personnel selection and assignment, were included to indicate their influence on the training system. Also, topics such as "The Training Estimate" were included as possible vehicles for classroom experience in the application of the techniques taught.

[4] Appendix B, Period No. 2, Annex A.
[5] Appendix B, Period No. 3, Annex C.
[6] Appendix B, Period No. 2, Annex A.

The job duties and the elaborated HumRRO procedure were used to derive a preliminary list of training objectives for each unit of instruction. The resulting preliminary course outline (Appendix A) consisted of 11 units of instruction estimated to require 120 classroom hours. The primary methods of instruction were lecture-conference and practical exercise.

Underlying the construction of this course outline were four assumptions: (a) The course was to be designed to train managers of training, not technicians who engineer training. (b) Students should acquire the tools with which to check, verify, and evaluate the performance of technicians whom they manage. (c) Some *limited* experience with the employment of techniques would be helpful to managers. (d) A major amount of practical work would be required to achieve managerial proficiency.

To obtain course content, the units of instruction were assigned to 12 members of the HumRRO research and research administration staffs who it was felt had the most appropriate background of education and experience (Table 2). These scientists wrote the lectures and constructed the practical exercises and examinations required for the preliminary course.

Table 2

HumRRO Personnel Responsible for Construction of Lesson Materials

Unit	Personnel	Division
I Future Assignments	Dr. Meredith Crawford	Director, HumRRO
II Systems	Dr. James McKnight	Division No. 1
III Performance Requirements	Dr. Robert Smith Dr. Robert Baker	Director's Office Division No. 2
IV Selection	Mr. William Osborn	Division No. 2
V Training Objectives	Dr. William Melching Dr. Robert Baker	Division No. 5 Division No. 2
VI Training Program	Dr. George Brown Dr. Joseph Ward Dr. Robert Baker Dr. Donald Haggard Dr. Norman Willard	Division No. 7 Division No. 3 Division No. 2 Division No. 2 Division No. 2
VII Training Resources	Dr. Norman Willard	Division No. 2
VIII Evaluation	Dr. Eugene Cogan Dr. Robert Baker	Director's Office Division No. 2
IX Assignment	Mr. William Osborn	Division No. 2
X Army Organization	Dr. Norman Willard	Division No. 2
XI Training Estimate	Dr. Robert Baker	Division No. 2
Student Examination	Mr. Shepard Schwartz	Division No. 2

The course outline and materials were then critiqued by the HumRRO Division No. 2 staff to determine whether the course was sufficiently systematized—the first objective of the study. The results of this critique were generally positive, indicating that enough

specific and systematized methodology was available to justify a course, and that if minor adjustments were made, the material would be organized to provide a consistent course of instruction on management functions.

Phase 2: HumRRO Presentation

Course Administration. During the final half of FY 67, HumRRO conducted the preliminary course as an elective for the Armor Officer Advanced Course (AOAC) at Fort Knox. Scheduling by the Armor School provided a series of two- and four-hour blocks of instruction during the period 24 January - 1 May 1957—a total of 120 course hours. As much as possible, the two-hour blocks were utilized for lecture-conference instruction and the four-hour blocks for practical exercises. Each unit of instruction was presented by the HumRRO scientist who had constructed it. The course was elected by 31 officers enrolled in AOAC 3-67.

Critique and Evaluation. A tentative evaluation was made on the basis of discussions with selected students and an anonymous, end-of-course critique written by each student. There were a few completely negative statements, but the majority of the students stated that the course "was worthwhile," "had definite value," and "has the potential for being an outstanding and beneficial program." However, it was felt that before this potential could be realized, several serious deficiencies would have to be corrected:

(1) The students did not have the background of basic and functional knowledge of the systems concept, training system engineering, and the Army training organization that the instructors had presupposed. They did not know, for example, the format or purposes of Subject Schedules or Small Development Requirements. Nor did they know the functions or structures of Army agencies having pertinent training responsibilities, and they were not aware of the responsibilities for training that officers of their rank are given within each of these agencies. Furthermore, they had had little experience with any aspect of the Army training system, except as students.

(2) The content of the course was not entirely consistent and the transition between instructional units was poor. Terminology varied with instructor. Units did not flow in a manner that would allow the student to estimate where he had been, or where what he was doing would take him. The practical exercises required long periods of data gathering by the student before he reached an enabling objective (such as writing task descriptions, training objectives, or lesson plans) or a terminal objective concerned with managing these activities. And some of the units of instruction, while they were relevant to training, were covered more fully in other courses provided by the Armor School.

(3) Finally, it was felt that the instructional techniques needed improvement. The use of a large number of visiting instructors had contributed to disorganization. The most frequently utilized method of presentation—lecture—was boring and probably much less effective, for an officer class, than the discussion method. But the effectiveness of discussions could be greatly enhanced by increasing the number of illustrations of the application of techniques to military problems, and by demonstrations during which the results of application could be observed in an actual Army situation.

Course Revision. On the basis of these criticisms, HumRRO personnel modified the course. Lectures were printed to be used as preparatory readings. The discussion method was emphasized during conference sessions, and more examples of military application of the techniques described in the reading assignments were included. Practical Exercises were shortened, and were reoriented to management requirements, with necessary data provided rather than being derived. Demonstrations of techniques-in-action in the Armor School were added. Introductory material to provide a background in the Army organization for training functions was added, while topics duplicating materials presented by other departments were deleted. The result was a 96-hour course (Appendix A).

Phase 3: HumRRO Presentations (Army observers)

Course Administration. It was planned that the modified 96-hour course would be presented by Army instructors with HumRRO assistance. However, at the time of scheduling, the Electives Division of the Armor School did not feel that it could provide adequate instructors, because of unexpected instructor turnover. An alternate plan was adopted under which five instructors from HumRRO Division No. 2 taught the course and potential Army instructors observed the classes.

The modified course was presented during the period 21 August 1967 - 12 March 1968 to 23 officers enrolled from AOAC 1-68. Two potential Army instructors observed the course. Again, because of unexpected Army instructor turnover, this arrangement was repeated during the period 17 October 1967 - 23 April 1968 for 19 officers enrolled from AOAC 2-68; one potential Army instructor observed the classes. For both courses, scheduling by the Armor School provided for two-hour blocks of instruction presented twice a week for a total of 96 hours.

Critique and Evaluation. At the completion of the third presentation of the course, each student completed a questionnaire estimating the value of the course for Army officers—the second objective of the study. The questionnaire (Appendix C) included estimates of the overall value of the course, its value for specific assignments, the extent to which each section of the course appeared to fulfill its stated objective, and changes that could be made to improve the course.

The results of the student appraisal indicated that the course was of substantial value in increasing understanding of Army training and the techniques that effective training requires. Students felt that the knowledge and skills acquired would be of value in most noncombat assignments; a surprising number thought the course was of value for some company and battalion level combat assignments. They rated its value to be equivalent to that of tactics and automotive courses, usually considered the most valuable part of the AOAC instruction.

However, the students did feel that the material could be improved so as to meet the instructional objectives more adequately. They suggested that a single text be written to exclude extraneous material in the current readings and present a more precise, coherent managerial sequence. They also suggested that the course be shortened by compressing most of the units. And they recommended that the course be presented as a "progressive elective,"[7] in order that both junior and senior officers become more aware of the TRAINMAN methods.

Phase 4: Army Presentation

On the basis of this appraisal, and parallel instructor opinion, the course was judged to have sufficient value for Army officers to justify its continued inclusion in the Electives Program. Additional HumRRO modification of the course, on the basis of student suggestions, was not feasible within the staffing and timing limitations of the project. Furthermore, the required changes were judged to be well within the capabilities of the Army. Therefore, the Army assumed responsibility for conducting the course.

Course Administration. The 96-hour course (Appendix A) was presented by the Army instructor to two officer classes: five students from AOAC 3-68 and 14 students from AOAC 2-69 elected the course. The instructor had participated in the HumRRO presentation and received some aid from the HumRRO instructors. However, no provision was made for formal interaction between HumRRO and the Army during this period.

[7] As defined by the Haines Board, a sequence of courses to be provided over an officer's Army career.

Thus HumRRO was not able to directly evaluate the Army's ability to provide instructors or offer the course on a continuing basis.

School Evaluation. The Armor School stated in its annual evaluation,[8] "... reaction to the research project is highly favorable; however, the project has not been completed in sufficient detail to be put into the Program of Instruction at this time." Also the School stated an intent "to utilize the results in developing a unit for the electives program and other instructional units as appropriate."

However, an unofficial critique provided by the Army instructor indicated a belief that, for this particular course, the instructor must possess considerable Army training and experience as well as a reasonable level of specific education in the behavioral sciences. These two prerequisites were, he felt, uncommon within the Army. He also suggested that the course (a) was much too long, (b) should be more closely integrated with CONARC Regulation 350-100-1,[9] and (c) "is very valuable training for the future field grade officer who might be involved in the management of training. Hence, it should be considered within the core curriculum and not the electives program."

COURSE MATERIALS

The results of the study consist of a set of lesson outlines for the 96-hour course (Appendix B), a selected list of supporting references (Appendix D), and the texts of supporting readings (Appendix E). The lesson outlines were intended as class guides for the instructor rather than as lesson plans for student use. Lesson plans were not written because it was felt that detailed supporting materials and aids should be based on Army finalization of the course.

DISCUSSION

The product of Work Unit TRAINMAN appears to have met the objectives that were set for it. A course in the management of training was found to be feasible and was constructed. The course was judged to be of value both by the AOAC students enrolled in it and by the Armor School which provided it. Also, the course was taught successfully by a military instructor.

However, both students and instructors have indicated improvements that could be made for the final course. The main suggestions were: (a) drastically reducing course length; (b) integrating the present approach with the CONARC Systems Engineering of Training; (c) tailoring supporting materials more closely to the course objectives; and (d) presenting the final course as a common subject, possibly as a "progressive" course for both junior and senior officers. The first three suggestions provide for modification to obtain a final, effective course in the management of training. The final suggestion provides a procedure for implementing that course into the Army training system.

Before discussing each of the above suggestions, some consideration should be given to the availability within the Army system of the expertise for further course development and instruction. It might be argued that experience with the present course has indicated that course development and instruction require the effort of personnel who have *both* a behavioral sciences background and reasonable knowledge and experience of

[8]Letter, 7 March 1969, CONARC ATIT-S, to CONARC ATIT-RD, Fort Monroe, Va., subject: Annual School Evaluation Staff Visits.

[9]U.S. Continental Army Command. *Training–Systems Engineering of Training (Course Design)*, Regulation 350-100-1, CONARC, Fort Monroe, Va., 1 February 1968.

the Army training system. The military instructor for the present course did have a Ph.D. in sociology; however, his Army experience was limited (he was a recent graduate of the Armor Officer Basic course) and this may have influenced his view of personnel availability. In fact, he stated in his critique, "I found the course quite difficult to prepare, especially when classroom discussion called for specific examples. My personal familiarity with the everyday problems of military training and training-related behavioral science research was limited."

However, the Army does have a fairly large number of officers who have had extensive experience in each phase of the Army's training system. Many of these officers have also received graduate education in one of the behavioral sciences. In addition, a number of Army educational advisers have always contributed significantly to the formulation of the Army's training system, and many of them contributed heavily to the planning and writing of the CONARC regulation, Systems Engineering of Training, which many military and civilian employees are now engaged in implementing. Thus, the Army does appear to possess adequate resources both for the development of a final training management course and for providing qualified instructors on a continuing basis.

Preliminary evaluations of the three suggestions for course modification indicate that all could be accomplished by Army personnel with minimal input from the instructors who presented the course. With regard to length, experience with the present course indicated a number of classes in which progress lags or for which course material is not directly relevant. Also, as the systems approach has become familiar to Army personnel, officers have gained a considerable amount of knowledge concerning its basic premises and have felt a change in attitude toward its practicality and applicability with the Army system. Thus, much of the highly technical material and much of the time devoted to trainee attitude modification could now be eliminated. It has been estimated that these changes might reduce the time scheduled for each unit of instruction so as to provide a final course of approximately 30 hours. It appears that reduction along these lines could retain, and even improve the focus on, the major elements of course content.

Again, little additional effort should be required to integrate the present course with the CONARC Systems Engineering of Training. The major points at which the course departs from this system are points at which background and attitudinal material were inserted to expand the HumRRO seven-step system for training development. In fact, both the HumRRO and CONARC systems have been very closely coordinated during their development. The HumRRO system presents the managerial functions and technological procedures for which CONARC has provided the administrative techniques. Re-emphasizing the essentials of the HumRRO system, by eliminating background and attitudinal material, should then automatically coordinate the course with the CONARC system.

This coordination should also provide a more concise set of supporting materials. Tailoring the present readings to fit the seven-step approach will allow for a more cohesive course structure and provide priorities for eliminating extraneous material. The products projected for the present HumRRO Exploratory Research 75, Methodology for Training Systems Engineering, will provide consolidated background readings and tentative performance guides for the technical aspects of the course.[10] The administrative techniques specified in CONARC Regulation 350-100-1, and the results of Army applications of it, could provide an integrated illustrative base.

These two sources of data may be combined and, by changing the emphasis given each, considered as a basis for implementing a progressive common subject for junior and senior officers. With the publication and use of the Systems Engineering of Training

[10] Human Resources Research Office. *Work Program for the Department of the Army—Fiscal Year 1970*, December 1969.

regulation, many junior officers, including an increasing number of lieutenants, are being taxed with responsibilities which require some of the training that the present course provides. Added to this are the requirements for increasing formalized on-the-job training, the systems and human requirements now being considered by the Combat Developments Command and the Army Materiel Command in their management models, and recent suggestions that commanders begin at once to implement new training methods and media. All these developments, and others, guarantee that practically every officer in the Army will have to deal with the problems addressed in this course. Thus, the reduction in time, and improved coordination between the course and the Army training system, offer a chance to provide the training needed for efficient accomplishment of these duties.

Emphasis on the practical administrative techniques provided by 350-100-1, with meaning and coherence provided by the modified background readings, could form a technology course for Officer Basic classes. Emphasis on the managerial functions of the present course, with a technological foundation provided by 350-100-1, could form a middle-management course for Officer Advanced classes. Also a centrally located School in Training Management for senior officers, similar to the present Army Maintenance Management Department at Fort Knox and the Army Management School at Fort Belvoir, could offer the training management essentials of the present course plus the latest media and methods techniques. Such a system of progressive training in training appears to be imperative if we are to expect an efficient Army training system.

APPENDICES

Appendix A

PRELIMINARY OUTLINE OF A COURSE OF INSTRUCTION ON TRAINING MANAGEMENT

Contents

COURSE OUTLINE				TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
I. FUTURE ASSIGNMENTS OF ADVANCED COURSE GRADUATES					1 HOUR	LECTURE CONFERENCE
A. AS S3 OF BRIG, BN, SQDN	B. AS ASST G3	C. AT SCHOOL, TRNG CNTR OR INSTRUCTOR GROUP	D. AT HIGHER HDQTRS AS CONARC OR D/A			
1. PERFORMANCE REQUIREMENTS		a. ESTABLISHES PERFORMANCE STANDARDS	a. REVIEWS ALL STANDARDS			
		b. DETERMINES JOB REQ WITH CDC	b. DETERMINES JOB REQ WITH CDC			
2. SELECTION (PROCUREMENT AND CLASSIFICATION)						
3. DETERMINATION OF TRAINING OBJECTIVES						
a. MAY SPECIFY TERMINAL OBJECTIVES, STANDARDS	a. ESTABLISHES TRNG STANDARDS FOR UNIT	a. DETERMINES TRNG OBJS (SCHOOL)	a. REVIEWS TRNG OBJS			
b. MAY SPECIFY, ENABLING OBJECTIVES	b. MAY SPECIFY TERMINAL, ENABLING OBJECTIVES					
4. TRAINING AND MOTIVATION						
a. IMPLEMENTS TRNG POLICY	a. ESTABLISHES TRNG POLICY	a. DETERMINES TRNG DEV REQ	a. REVIEWS TRNG DEV REQ			
b. PREPARES PROG, GUIDANCE FOR UNIT TRNG		b. ESTABLISHES TRNG POLICY	b. ESTABLISHES TRNG POLICY			
		c. PREPARES TRNG PROG AND POI	c. REVIEWS TRNG PROG AND POI			
c. SUPERVISES TRNG WITHIN UNIT (OJT)		d. CONDUCTS TRNG (LECT, CONF, PE.)				
5. MGMT OF TRAINING OPERATIONS						
a. ORGANIZES, MANAGES LOCAL SCHOOLS-DIRECTS ROUTINE TRNG OPNS-PREPARES DIRECTIVES ON TRNG-	a. ORGANIZES SCHOOLS, TC'S TRNG COMMS.	a. MANAGES INSTRUCTOR GROUP	a. RECOMMENDS, REVIEWS TRNG PERS CHANGES			
b. PROCURES, DISTRIBUTES TRNG AIDS, FACILITIES, AND AMMO	b. SUPPORTS TRNG OPNS	b. SUPPORTS TRNG OPNS, DETERMINES MATERIEL AND PERSONNEL REQ	b. REVIEWS ATT, ATP, ASUBJ S			
c. OUTLINES PLAN TO ACCMP TRNG MISSIONS - SCHEDULES TRNG	c. COORDINATES TRNG OPNS	c. COORDINATES TRNG OPNS (SCHEDULES)	c. REVIEWS TRNG LIT			
d. PROCURES, USES TRNG LIT, TRNG CIRCS, DIRECTIVES, ETC.	d. PREPARES, OBTAINS TRNG LIT	d. PREPARES ATT, ATP, ASUBJ S				
e. PREPARES AND SUBMITS TRNG RECORDS		e. PREPARES, REVIEWS TRNG LIT				
6. EVALUATION OF TRAINING						
a. SUPERVISES, CONDUCTS TESTING, INSPECTS AND EVALUATES PERF (QUAL CONT)	a. MONITORS TRNG PROGRESS (PROF TESTS)	a. MONITORS STUDENT PROGRESS/QUALITY CONTROL ON D/I STAFF	a. REVIEWS, CONDUCTS QUALITY CONTROL	STUDENT MUST LIST FOUR TYPES OF FUTURE ASSIGNMENT REQUIRING TRAINING MANAGEMENT SKILLS AND IDENTIFY THE DIFFERENCES IN TASK FUNCTIONS BETWEEN THE FOUR TYPES OF ASSIGNMENT. (ENABLING)		
b. KEEPS RECORDS OF TEST AND INSPECTION DATA						
7. ASSIGNMENT OF PERSONNEL				STUDENT MUST BE ABLE TO IDENTIFY AND TO DISTINGUISH BETWEEN THE EIGHT PERSONNEL AND TRAINING FUNCTIONS THAT ARE RELEVANT TO TRAINING MANAGEMENT IN THE FOUR TYPES OF FUTURE ASSIGNMENTS. (ENABLING)		
a. REQUESTS, FILLS, ALLOCATES QUOTAS FOR SCHOOLS						
8. DETERMINATION OF STUDY REQUIREMENTS	a. APPROVES, STAFFS STUDY (RESEARCH) REQS.	a. ESTABLISHES STUDY (RESEARCH) REQS.	a. REVIEWS, ESTABL STUDY (RESEARCH) REQS.			

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
II. Systems, Missions, Mission Definition, and Mission Accomplishment		5 HRS	
A. The Concept of a System 1. The Role of System in Mission Accomplishment 2. The System Performance Requirements (Performance Standard)	Student must be able to explain the concept of a system with respect to the role of the system in a stated mission and the standards for system performance. (ENABLING)		Lecture Conference
B. Defining the Mission of the System 1. Determining the Goals of the System a. Definition of Goal b. Procedures for Determining Goals 2. Determining Action Requirements to Obtain Stated Goals a. Definition of Action Requirements b. Procedures for Determining Action Requirements 3. Determining Precise Output Requirements for Accomplishing Actions a. Definition of Output Requirements b. Procedures for Determining Output Requirements 4. Specifying Output Standards a. Definition of Output Standard b. Procedures for Specifying Standards	Student must be able to list the four functions which define the mission of a system. (ENABLING)		Lecture Conference
C. Mission Accomplishment 1. Resources a. Financial (1) Budget Estimate (2) Procurement of Funds (3) Disbursement b. Technological (1) Equipment (2) Concepts c. Personnel (1) Manpower Pool (2) Human Capacities	Student must be able to list the three types of resources available for mission accomplishment and define the sources of information for each resource. (ENABLING)		Lecture Conference
2. Functions Required a. Resource Mgmt. (1) Financial (2) Technological (Equipment) (a) Requirements (b) Design (c) Procurement (d) Maintenance (3) Personnel (Manpower) (a) Requirements (b) Recruiting (c) Classification (d) Training (e) Assignment	Student should be able to explain the three management functions required for mission accomplishment. (ENABLING) The student should be able to explain the relationship between the three types of resources in fulfilling the management functions in mission accomplishment. (ENABLING)		Lecture Conference

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
b. Operations (1) Planning (2) Support (3) Execution (4) Quality Control c. Research and Development (1) Concepts (2) Equipment (3) Human	(See objective for II. C. 2.a)		Lecture Conference
3. The Subsystem and its Role a. Relation of Subsystem to Achievement of System Performance Requirements	Student must be able to provide a quantitative statement of the relationship between achievement of subsystem goals and achievement of system goals. (ENABLING)		Lecture Conference
(1) Identifying Enabling Steps in System Performance (2) Determining Subsystem Standards (a) Relation to System Standards (b) Accuracy (c) Time (d) Cost (e) Inter-relationship of Subsystem Activity and Standards (3) Subsystem Operating Conditions (a) Environment (b) Policy 1) Operations 2) Personnel	Student must be able to describe the procedure for establishing subsystem performance standards. (ENABLING)		Lecture Conference
(4) Man-Machine Allocation Decisions	Student must be able to demonstrate how performance requirements within a subsystem, such as a tank are allocated between man and machine. (ENABLING)	(2 Hrs)	Lecture Conference Practical Exercise
b. Determine Human Performance Requirements (1) Specify Tasks (2) Establish Performance Standards (3) Identify Human Requirements (a) Physical Characteristics (b) Quantity (c) Skills and Knowledges	Student must be able to list the three steps in determining human performance requirements. (ENABLING)		Lecture Conference
c. Develop the Required Personnel (1) State Performance Requirements (2) Select Personnel (3) Determine Training Objectives (4) Train and Motivate Personnel (5) Manage Training Operations (6) Evaluate Training (7) Assign Personnel (8) Determine Study Requirements d. Perform Subsystem Mission	Student must be able to describe the relation of each of the eight personnel and training functions to the accomplishment of the field army mission. (ENABLING)		Lecture Conference
		(30 Min.)	EXAMINATION

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
III. Establishing Performance Requirements		16 Hrs	
A. Establish Standards 1. Relation to System Output 2. Use of Behavioral Terms	Student must be able to identify quantifiable performance descriptors usable in the establishing of performance standards. (ENABLING)		Lecture Conference
3. Determining Validity 4. Determining Costs and Cost/Effectiveness Ratios	Student will be required to select one MOS from the Combat Support MOS's (05B20, 63B20, 71B20, 71H20, 76B20 or 94B20) and establish the performance standards for that MOS. (TERMINAL)	(3 Hrs)	Practical Exercise
B. Determine Human Performance Required to Meet Standards 1. Identify Sources of Information on Performance Requirements a. Functional Analysis of Equipment b. Similar Existing Systems and Positions c. Manufacturer's Personnel, Documents, and Publications d. Military Documents and Publications e. Job Incumbents f. Supervisors g. Users h. Job Equipment Records i. Interviews, Questionnaires, Check Sheets, and Job Diaries	The student must be able to identify the nine sources of information on job performance requirements. (ENABLING)		Lecture Conference
2. Select Basis for Deriving Performance Requirements a. Criticality b. Difficulty 3. Select Methods of Deriving Performance Requirements a. Conventional b. Short Cuts 4. Apply Selected Methods 5. List Performance Requirements a. Tasks and Task Elements (1) Cues (2) Responses (3) Standards b. Nature of Interaction (1) Equipment Oriented (2) Man Oriented	Students must list the performance requirements conditions of performance, and standards of performance of all of the elements under two of the tasks within one of the duties of one selected Combat Support job. Student must determine all of the tasks within the selected duty. In addition, the student must list all of the tasks within one duty of an officer who is charged with the management of a man-dominant system. The duty will be prescribed and will be selected to be representative of personnel and inter-personal situations. (TERMINAL)	(6 Hrs)	Lecture Conference Practical Exercise
6. Develop Methods of Getting Corrective Feedback From the Field	The student must be able to outline two methods of getting feedback on performance requirements from the field. (ENABLING)		Lecture Conference

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
C. Group Similar Performance Requirements 1. Reasons for Grouping a. Job Specification b. Training Efficiency	Student must be able to state the two reasons for grouping and the four bases for grouping similar performance requirements (ENABLING)		Lecture Conference
2. Basis for Grouping a. Performance Requirements b. Location c. Time (Temporal Relation) d. Career Considerations	Student will analyze the performance requirements prepared for several tasks, group similar requirements according to the four bases for grouping decisions. (TERMINAL)	(1 Hr)	Practical Exercise
D. Obtaining the Required Performance 1. Methods of Obtaining Performance a. Selection b. Training c. Job Aids d. Job Redesign	Student will modify a task statement requiring job redesign and a statement requiring the use of job aids. (TERMINAL)	(1 Hr)	Practical Exercise
2. Criteria for Selecting Methods a. Importance (Criticality) of Performance b. Cost of Method c. Difficulty of Method	The student must be able to indicate the criteria for the selection (identification) of tasks for which training will be critical. (ENABLING)		Lecture Conference
E. Identify Skill and Knowledge Requirements 1. Select Procedure for Identifying Skill and Knowledge Requirements	Student must be able to describe the five common bases for classifying skills and knowledges. (ENABLING)		Lecture Conference
2. Specify Skill and Knowledge Requirements a. Physical Characteristics b. Motor Skills c. Perceptual Skills d. Retentive Skills e. Knowledges	Student must determine and classify the skill and knowledge requirements for one task of a job duty from the selected Combat Support MOS. (ENABLING)	(1 Hr)	Practical Exercise
3. Verify Skill and Knowledge Requirements Against Performance Standards a. Tolerance (Accuracy) b. Speed Requirements	Student will compare the obtained skill and knowledge requirements with the obtained performance standards for completeness, accuracy, redundancy, ommissions, and irrelevancies. (TERMINAL)	(1 Hr)	Practical Exercise
		(1 Hr)	EXAMINATION

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
IV. Selection of Personnel		1 Hr	
A. Identify Personnel Entry Characteristics Required B. Procure Personnel 1. Recruit a. Naive b. Experienced (Skilled) 2. Transfer 3. Entry Characteristics of Available Personnel	Students must be able to list sources of manpower and to describe the characteristics from each source. (ENABLING)		Lecture Conference
C. Classify Personnel 1. Select Appropriate Tests a. Aptitude b. Skill c. Interests d. Preferences	Students must be able to distinguish between the types of tests used in the selection and placement of personnel. (ENABLING)		Lecture Conference
2. Identify the Purpose of the Testing a. Assignment (1) Job (2) Training b. Rejection 3. Establish Validity of Tests and Cut-Off Scores	Student must be able to describe three purposes of selection testing. (ENABLING)		Lecture Conference
4. Establish Manpower Cataloging System (i.e., MOS System)	Students must be able to locate the MOS description for any specialty in the Army system. (TERMINAL)	(¼ Hr)	Lecture Practical Exercise
V. Derivation of Training Objectives for a Specific Training Program		12 Hrs	
A. Instructional Aim and Scope	The student must prepare a set of instructional aims for a specific training program for a selected MOS. (TERMINAL)	(2 Hrs)	Lecture Conference Practical Exercise
B. Terminal Student Performance Objectives for Each Operational Level 1. Specific Tasks 2. Generalized 3. Generalized Behaviors C. Deriving and Specifying Enabling Objectives	The student, using the performance requirements, must prepare a set of terminal objectives for two tasks of a selected job duty and, using the skill and knowledge requirements, must prepare a set of enabling objectives for one task. (TERMINAL)	(8 Hrs)	Lecture Exercise Practical Exercise
		(1 Hr)	EXAMINATION

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
VI. Development of the Training Program		40 Hrs	
A. State Standards of Performance to be Achieved B. Use of Objectives in Preparing Training C. Identify Personnel to be Trained 1. Individuals a. Technicians b. Instructors 2. Units	Students must be able to relate the performance standards of Topic III.A. to the performance standards for training, to utilize the training objectives (Topic V.) in outlining training, and to identify the characteristics of personnel to be trained. (ENABLING)		Lecture Conference
D. Identify Administrative Guidelines 1. Types of Training a. Qualification b. Refresher c. Remedial d. New Concept or New Equipment 2. Training Organizations Available a. Training Centers b. Schools c. Correspondence Courses d. College ROTC Programs e. OJT	Student must be able to describe the training advantages which accrue from employment of the functional context technique. (ENABLING)		Lecture Conference
3. Administrative Procedures a. Multi-level Training b. Full vs Part-time Training c. Ability Grouping d. Individualized Instruction e. Programed Instruction f. Functional Context Organization 4. Training Philosophy, Policies, and Practices	Student must identify the training philosophy and policies governing the specification of the responsible organizations and the necessary administrative procedures for providing NET for the MOS selected and considered in Section V. (TERMINAL)	(1 Hr)	Practical Exercise
E. Employ Learning Principles and Training Concepts 1. Knowledge of Results 2. Part vs Whole Learning 3. Distribution of Practice 4. Guidance or Prompting 5. Stimulus Intensification (Simplification-Distinctiveness) 6. Passive vs Active Participation 7. Meaningfulness, Instructional Set, and Attitudes 8. Mediation and Direct Associative Conditioning 9. Transfer of Training a. Similarity and Interference b. Abilities (Skills) and Knowledges	Student must be able to explain the relationship between training philosophy and the utilization of training principles, concepts, and techniques. (ENABLING)		Lecture Conference

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
F. Employ Training Techniques 1. Lecture - Instructor Dominant	Student must identify strengths and weaknesses of the lecture method of presenting material. (ENABLING)		Lecture Conference
2. Student Participation Techniques a. Role Playing b. Games c. Practical Exercises d. Classroom Communication Devices e. Group Discussion, Conferences f. Case Study Method g. Many Training Devices, Aids, Simulators, etc.	The student must be able to describe five techniques for eliciting student participation. (ENABLING)		Lecture Conference
G. Employ Instructional Aids 1. Types a. Television b. Movies c. Slides d. Demonstration e. Teaching Machines f. Computer-Assisted Instruction g. Scrambled Books h. Conventional Publications i. Many Training Devices, Aids, Simulators, etc. 2. Principles of Utilization a. Self-paced vs Paced b. Automated	Student must be able to describe six types of instructional aids and relate their use to training philosophy, training objectives and learning principles. (ENABLING)		Lecture Conference
H. Select or Develop Training Literature to be Used 1. Types of Training Literature a. Directives b. Circulars c. FM's d. TM's e. ATP's f. POI's	Student must be able to list and describe the forms of training li.erature prepared by CONARC and indicate the appropriate level of utilization for each form. (ENABLING)		Lecture Conference
g. A Subject Scheds. h. Lesson Plans i. Pamphlets 2. The Development of Training Literature	The student will be required to review one Army Training Circular or Field Manual and comment on its performance relevance. (TERMINAL)	(4 Hrs)	Practical Exercise
I. Select or Develop Training Aids, Devices and Films 1. Requirements 2. Funding			Lecture Conference
3. Fabrication 4. Preparation of Utilization Packages 5. Service Test of Reliability and Durability 6. Troop Test of Validity	The student must develop or review a set of specifications for a training device or set of training devices for a task. (TERMINAL)	(4 Hrs)	Practical Exercise

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
J. Design Motivation and Behavior Control Techniques for Training 1. Identification of Needs and of Reinforcers 2. Criteria for Rewards and Incentives 3. Schedule of Reward 4. Types of Reward a. Passes and Other Privileges b. Awards - Recognition c. Individual or Group 5. New Developments in Behavior Control a. Shaping b. Reinforcement (Homme, Lloyd E.)	The student must be able to describe four methods for motivating or controlling behavior in a formal school setting. (ENABLING)		Lecture Conference
	The student must prepare an instructional unit for one task from the duties of one Combat Support MOS. Students should use previously derived training objectives, employ at least two learning principles, one behavior control procedure and at least two training techniques. This program must be given a pilot test using at least five students. After the program has been pilot tested, it must be revised and administered to a second group of five students. (TERMINAL) The student will be required to develop a training unit which will increase skill, among young officers, in personnel management. (TERMINAL)	(16 Hrs)	Practical Exercise
		(2 Hrs)	EXAMINATION

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
VII. Management of Training Resources		10 Hrs	
A. Training Areas and Environment 1. Classroom or Field 2. Desk and Work Areas 3. Visibility 4. Audibility 5. Temperature - Humidity 6. Clothing	Student must be able to list training area and environmental factors which must be considered in managing training. (ENABLING)		Lecture Conference
B. Instructor Training 1. Defining Objectives 2. Preparation Time a. Reading b. Writing - Programing c. Rehearsing d. Testing Effectiveness 3. Developing Support a. Aids and Devices b. Publications c. Assistant Instructors 4. Providing Student Feedback 5. Developing Tests and Testing Procedures 6. Utilization of Automation	The student must outline a plan for instructor training, including a discussion of programing of instruction and of techniques of training evaluation. (TERMINAL)	(4 Hrs)	Practical Exercise
C. Implementing Documents 1. Preparation or Procurement 2. Distribution	The student must review an existing ATP for one Combat Support MOS and, then, prepare the required A Subj. Sched. (TERMINAL)	(2 Hrs)	Lecture Practical Exercise
D. Management of Time (Scheduling)	The student must prepare an OJT training schedule for the training of replacements in one of the Combat Support MOSs (i.e., MOS 05B20, 63B20, 71B20, 71H20, 76B20 and 94B20). (TERMINAL)	(2 Hrs)	Lecture Conference Practical Exercise
		(1 Hr)	EXAMINATION

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
VIII. Evaluation of the Efficiency of Training		20 Hrs	
A. General Purposes 1. Exercising Quality Control 2. Guiding Training Modifications 3. Prescribing Remedial Training	Student must be able to explain the three purposes for evaluating training efficiency. (ENABLING)		Lecture Conference
B. Specification of Behavior to be Measured 1. Behaviors Derived from the Job Description 2. Weighing Component Aspects of Performance 3. Criteria for Skill Levels a. Qualification b. Proficiency c. Mastery 4. Measuring Terminal Versus Enabling Objectives	Student must be able to describe the procedures to be followed in specifying the behaviors to be measured. (ENABLING)		Lecture Conference
C. Types and Characteristics of Proficiency Measures 1. Performance vs Written Tests 2. Objective Tests (Performance) vs Subjective Estimates (Ratings) 3. Job-sample Measures vs Performance on Simulated Tasks 4. Component Performance Measures vs Subsystem Performance Measures 5. Three Levels of Measurement of Terminal Objectives a. Performance b. Plan-to-do c. Knowledge Recall	Students must be able to identify the types of evaluation instruments and the purposes for which they may be used. (ENABLING)		Lecture Conference
D. Accuracy of Measurement in Assessing Job Proficiency 1. Reliability and Unsystematic Errors 2. Validity and Systematic Errors	The student must be able to list factors contributing to test unreliability (i.e., ambiguity in items or in instructions, poor testing conditions, etc.) The student must critique a test from the standpoint of clarity of instructions and the objectivity and reliability of the scoring procedure. (TERMINAL)	(2 Hrs)	Lecture Conference
	The student must determine the reliability of test results using simple computational procedures. (TERMINAL)		Practical Exercise

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
E. Evaluation of Individual Achievement 1. Select Types of Evaluation Instruments a. Proficiency Tests b. Mastery Tests c. Readiness Tests 2. Identify the Purpose of Evaluation a. Qualification b. Pay c. Promotion d. Retention e. Retraining	The student will be required to prepare a performance proficiency test for one task of the selected Combat Support MOS duties. Next, he will be required to prepare a written test on the same task. (TERMINAL)	(4 Hrs)	Lecture Conference Practical Exercise
F. Evaluation of Team, Unit, or Group Proficiency 1. Types of Evaluation Instruments a. Field Performance Tests b. Simulated Exercises 2. Purposes of Evaluation a. Assess Training Status b. Certification of Readiness	The student must develop one platoon proficiency test of offensive tactical operations. Emphasis must be on objectivity, reliability and validity. (TERMINAL)	(4 Hrs)	Lecture Conference Practical Exercise
G. Evaluation of Training Program Efficiency 1. Basis of Evaluating Program a. Cost b. Student Achievement c. Student Behavior on Job	The effectiveness of the pilot training program developed by the student of this course must be evaluated in terms of its training effectiveness and cost. (TERMINAL)	(4 Hrs)	Lecture Conference Practical Exercise
2. Methods of Evaluating Program a. Before and After Assessment b. Quantitative Measures of Achievement (1) Speed (2) Errors (Accuracy)	The student must organize a quality control system to monitor the OJT MOS training within a battalion-size organization. (TERMINAL)	(2 Hrs)	Practical Exercise
3. Purposes of Evaluation a. Quality Control b. Identification of Training Weaknesses c. Comparison of Training Methods d. Evaluation of the Efficiency or Effect of Program Variables	The student must develop a general design of a quality control system for a school or ATC. (TERMINAL)	(2 Hrs)	Practical Exercise
		(1 Hr)	EXAMINATION

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
IX. Assignment of Personnel		1 Hr	
A. Proper Utilization B. Recognize Mal-assignment	Student must be able to estimate the impact of mal-assignment upon the personnel and training subsystem. (TERMINAL)		Lecture Conference
X. The Army's Organization for Utilization of Personnel for Mission Accomplishment		4 HRS	
A. Combat Developments Command 1. Branch Agencies 2. CDEC B. Office of Personnel Operations 1. Enlisted Personnel Directorate 2. Officer Personnel Directorate 3. Enlisted Evaluation Center C. Army Materiel Command D. Office of Chief of Research and Development 1. Human Engineering Laboratory 2. Army Personnel Research Office 3. Human Resources Research Organization 4. Center for Research in Social Studies 5. The Army Participation Group, USNTDC E. CONARC 1. Schools 2. Training Centers F. Active Field Armies G. Reserve Components	Student must be able to relate the functions of CDC, OPO, AMC, OCRD, CONARC, the field armies and reserve components in the area of establishing personnel requirements, personnel management and training to meet the human performance requirements of the Army as a system. (ENABLING)		Lecture Conference
		(1 Hr)	EXAMINATION

COURSE OUTLINE	TRAINING OBJECTIVE AND TYPE	HOURS	METHOD OF PRESENTATION
XI. The TRAINING ESTIMATE, as the Tool of Training Supervision		10 HRS	
A. Definition of the Training Estimate B. Purpose of the Training Estimate C. Contents of the Training Estimate 1. The Mission - In Terms of Performance Standards (Subsystem Requirements) 2. Evaluation of Existing State of Proficiency (Readiness) 3. Current Training Requirements 4. Time Available for Training 5. Publications Available 6. Training Methods Available 7. Equipment Available 8. Facilities Available 9. Environmental Factors 10. Organization for Training a. Committee b. Unit 11. Plan for Administering Training 12. Plan for Supervision of Training (Quality Control)	The student must be able to list the contents of the Training Estimate. (ENABLING)		Lecture Conference
D. New Developments in Training Technology	The student must be able to list the principal sources of information about new developments in training technology. (ENABLING)		Lecture Conference
E. Review Present Army Personnel System and Practices	Student must critique the Army personnel subsystem and the policies on selection, classification and assignment as they relate to training. (TERMINAL)		Lecture Conference
	Student will be required to review the present MOS statement for the selected Combat Support MOS and critique the entry characteristic requirements and the utility of the statement in determining the training objectives for the selected MOS. (TERMINAL)	(2 Hrs)	Practical Exercise
F. Review Present Army Training Practices and Policies	Student must participate in a symposium which is directed at reviewing the present Army training practices and policies. (TERMINAL)	(2 Hrs)	Practical Exercise
G. Identify Training Research Requirements			Lecture Conference
		(4 Hrs)	EXAMINATION

Appendix B

LESSON OUTLINES

Contents

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 1

LESSON OUTLINE

INSTRUCTIONAL UNIT: INTRODUCTION/OVERVIEW

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Norman Willard

TRAINING AIDS: None

REFERENCES: Crawford, M. P., HumRRO Techniques in Course Development (Published)

ASSIGNMENTS: Read references

OBJECTIVE: Student must gain overview of course objectives and procedures to facilitate the planning of his student performance

1. INTRODUCE INSTRUCTORS AND DESCRIBE HumRRO

a. Instructors' backgrounds in research on military training.

b. HumRRO: Mission; organization; relation to R&D, HFORD, BSRL, CONARC, etc.; products (Crawford, pp. 1-4).

c. HumRRO Division No. 2: Mission; organization; relation to CONARC, The Armor School, USATCA, etc.; products.

2. DEVELOPMENT OF THE TRAINING COURSE

a. HumRRO's interest in a course in training management for Army Officers.

b. The Haines Board "elective" program; The Armor School; support by The Armor School and R&D.

c. Possible future use in The Armor School's core curriculum and extension to other Service Schools.

3. COURSE PROCEDURES

a. Emphasis on reading assignments, discussion, and training documents.

b. Minimize lectures.

c. Emphasis on preparing student to direct and critique the process of developing and evaluating training programs, as against performing such development and evaluation.

4. COURSE OBJECTIVES

a. Change of students' behaviors and attitudes in studying and solving Army training problems.
b. Course objectives based on a survey of future assignments of AOAC graduates in recent years.

5. DIVISIONS OF THE COURSE (Crawford, pp. 4-10)

a. Block I: Introduction--Training Systems Analysis; Future Assignments.
b. Block II: Systems--Introduction to Systems and Systems Analysis Theory; The Army as a System; The Army's Training System.
c. Block III: Training Analysis--Mission Requirements and Standards Performance Requirements; Job and Task Analysis; Training Objectives.
d. Block IV: Training Program Development--Training Methods; Training Administration.
e. BLock V: Evaluation or Quality Control of Training and the Training Program.
f. Block VI: Army Training Management Responsibilities--CDC, AMC, CONARC, OPO, etc.

6. EXAMINATIONS

a. Where feasible, exams will consist of writing or critiquing Training Programs, POIs, Army Subject Schedules, etc.
b. Conventional essay or multiple-choice exams will be used to measure general knowledge of key terms and concepts.
c. Final Exam: To prepare answer to handout letter, "To CONARC/DCSIT . . . May, 1967." (Annex A)

Period No. 1, Annex A

HumRRO RESEARCH PROJECT - ENLISTED MOS TRAINING OBJECTIVES

1. Pursuant to authority contained in paragraph 27, CON Reg 350-1, it is requested that the Human Resources Research Office (HumRRO) conduct a research project to resolve the following problem: To what extent should "duties" and "skills and knowledges" be taught in MOS-awarding courses conducted by Army service schools, specifically MOS ______ and ______?

2. The major questions to be answered concerning this problem are as follows:

a. Should training prepare the student to perform every aspect of an MOS proficiently?

b. The utilization of the MOS description; i.e., "Duties" and "Skills and Knowledges" needs clarification. For example, should training, school or OJT, be confined to "duties" or "skills and knowledges," or should both be utilized?

c. Should every subject taught, relating to an MOS, be at the "qualified" level as defined in paragraph 19, Annex Q, CON Reg 350-1, dated 17 June 1964? If negative, how should the three levels of knowledge be applied?

d. Should the student be trained to perform proficiently duties, MOS-related, for a specific period of time? For example, should the course be geared to teaching the student those functions he will be expected to perform for the first six months of his duty assignment? If affirmative, how should this time frame be determined?

e. Should the student be trained to perform proficiently duties expected of a particular rank; for example, should the student be trained to perform the duties of an E-2, E-3, E-4, etc.? If affirmative, how will the rank be determined and how should the duties associated with a particular rank be determined?

f. Should all training be conducted at service schools or should some on-the-job training (OJT) be a prerequisite prior to awarding an MOS?

(1) If all training should be conducted at service schools, what considerations should be made as to length of time training should be conducted? For example, if it takes 26 weeks to fully qualify an E-2 having a 24-month active duty commitment, his productive time remaining would be little more than one year.

(2) If partial training should be by OJT, what considerations should be given as to the length of time school training and OJT should be conducted?

g. To what degree of accuracy should an enlisted man be able to perform upon the award of an MOS: 90%, 95% or 100%?

FOR THE COMMANDANT:

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 2

LESSON OUTLINE

INSTRUCTIONAL UNIT: INTRODUCTION/TRAINING SYSTEMS ANALYSIS

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Mr. Shepard Schwartz

TRAINING AIDS: 35 mm slide projector, slide Annex A

REFERENCES: Crawford, M. P., HumRRO Techniques in Course Development (Published)
Sayles, L. R., Managerial Behavior (Published)

ASSIGNMENTS: Study Crawford, pp. 4-10; Read Sayles, Chapter 2

OBJECTIVE: To provide the student with a knowledge of the background of the HumRRO approach to training systems analysis and the operational steps it involves

1. Training-Systems Analysis (TSA)--a branch of general systems analysis--is an orderly way of studying training systems, in order to evaluate their effectiveness and recommend improvements. Among the other branches of systems analysis are Management Systems Analysis, Information Systems Analysis, etc.

2. The concepts and procedures utilized in TSA were derived mainly from Systems and Systems Analysis Theory.

3. Using these concepts and procedures--and others from the fields of psychology, sociology and human factors research--HumRRO, over a period of years, developed a standardized approach for studying Army training systems and Army training problems (Crawford).

4. Although the HumRRO method of TSA was developed for Army use, it is applicable to training systems in general--military or non-military.

5. The approach is useful for studying on-going training, and for planning training on jobs--or job changes--generated by the development of new equipment or new concepts.

6. The approach is "job"oriented--the study of training begins with a study of the job.

7. The approach is "systems" oriented--the study of the job begins with a study of the sub-system in which the job is performed.

8. The HumRRO method of TSA consists of seven operational procedures, or steps. (Slide Annex A) The seven steps are:

a. Analysis of the military sub-system (unit) in which the job under study is performed. What is the mission of the system? What are its inputs and outputs? What men does it employ? What machines? With what other sub-systems does it directly interact?

b. Analysis of the particular job. What are the duties and tasks performed in the job? What are the inputs and outputs? Under what conditions does the man perform his job, and what standards must his performance meet? With which other men in the sub-system does he interact?

c. Development of a measure of job proficiency. This step requires the construction of a test of the proficiency with which a man performs the tasks required by the job. As nearly as is possible, this test must impose the same job conditions existing in the fields, and must utilize realistic performance standards of job output.

d. Specification of the knowledges and skills required to perform the job. What knowledge and skills are required to perform the tasks required on the job? What sensings? Memory references, analyses, decisions must be made in order to perform the job behaviors for which the training is intended.

e. Determination of training objectives. What training objectives should be established with regard to the knowledges and skills required to perform the job? Which of these knowledges and skills does the trainee population already have? At what level are course graduates expected to perform on initial job entry? Discuss "general," "terminal," and "enabling" objectives; discuss "generalized attitudes."

f. Construction of the training program.
   (1) Sequencing of materials
      (a) Whole - Part - Whole
      (b) Functional context
   (2) Methods of instruction
      (a) Conventional--lecture, illustration, practice, self-study, etc.
      (b) Developmental--"programming," computer-assisted, etc.
   (3) Practice
      (a) Spacing
      (b) Training devices
   (4) Within-course testing
      (a) Emphasis on "enabling" objectives
      (b) Terminal objectives tested in "proficiency measure"
      (c) Knowledge of results useful in determining "when to stop or continue"

g. Evaluation of the training program.

(1) Evaluation should be conducted by an agency independent of the planning and administration of training.

(2) It should normally be made in terms of the proportion of students that attain the minimal level of proficiency required to meet system objectives.

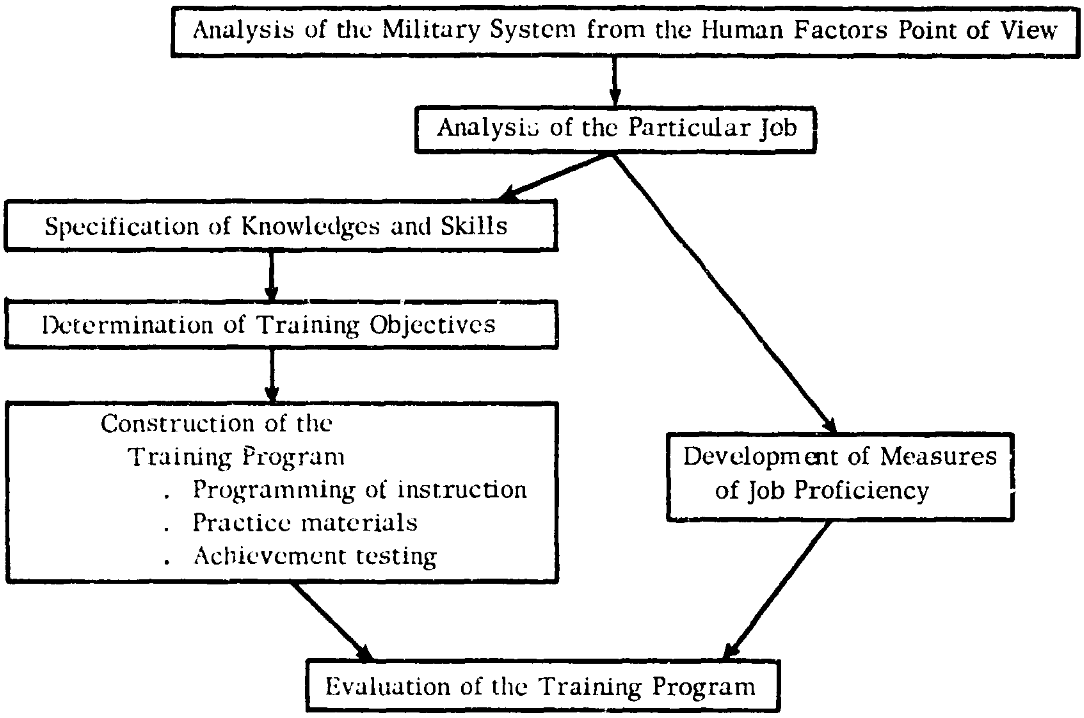
(3) It should also be made in terms that permit identifying specific types and areas of weakness.

9. The seven steps are normally performed in the order listed above; however, some steps may be combined, depending on the nature of the problem.

Period No. 2, Annex A

35 mm SLIDE

STEPS IN THE DEVELOPMENT OF TRAINING



HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 3

LESSON OUTLINE

INSTRUCTIONAL UNIT: INTRODUCTION/FUTURE ASSIGNMENTS

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)
Annex B (one per student)
Annex C (one per student)

PERSONNEL: Mr. Shepard Schwartz

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

OBJECTIVE: To provide student with a knowledge of the major types of military jobs to which he is likely to be assigned following graduation from AOAC, and the training functions performed in these jobs

1. HIGH PROBABILITY FUTURE ASSIGNMENTS (Annex A)

2. SURVEY OF 50 AOAC GRADUATES

a. Objective. To obtain information about the kinds of assignments held, and the training functions performed in these assignments. (Reading down left-hand column: "54% of graduates studied reported they had been assigned as Company Commanders at some time after graduation from AOAC." Reading across: "89% of these officers reported that preparing training schedules" was one of the training functions they performed.)

3. SURVEY METHODS (Annex B)

a. The survey was conducted at Fort Knox in October, 1966.
b. In categorizing responses on kinds of training functions performed, those activities having generally to do with "planning and training" were labelled with an initial digit "1"; "conduct of training" - initial digit "2"; "evaluation of training" - initial digit "3".
c. Student questions about survey methods.

4. GENERAL FINDINGS (Annex C)

a. At company level, training functions consist mainly of scheduling, conducting, and supervising training; and interpreting training policies to subordinates.

b. At battalion level, training functions consist mainly of inspecting and evaluating and supervising training; of formulating and explaining training policy; and of reviewing and explaining training objectives.

c. At AG-3 staff level, training functions consist mainly of formulating and explaining policy; or formulating, reviewing, and explaining both training policy and training objectives; and of evaluating training.

d. At Service School level, training functions consist mainly of preparing, reviewing and explaining training literature and training objectives.

PERIOD NO. 3, ANNEX A

ARMOR			BASIC MILITARY DEVELOPMENT	INTERMEDIATE PROFESSIONAL DEVELOPMENT	ADVANCED CONTRIBUTION AND DEVELOPMENT	MAJOR PROFESSIONAL CONTRIBUTION
OBJECTIVES FOR PERIODS INDICATED			Provide and develop fundamental knowledge by: a. Attendance at the basic and advanced course. b. Troop command duty at platoon and company level. c. Troop staff duty at battalion and brigade level. d. Service school instructor duty.	Improve military stature and broaden professional competence through: a. Troop staff and command duty at battalion level. b. Staff duty at brigade, division and higher level. c. Service school instructor duty. 4/ d. Civilian component duty. e. Duty with MAAGs and Missions. f. Attendance at CGSC or AFSC for selected officers.	Demonstrate potential in positions of high responsibility and continue professional development through: a. Command duty at battalion and brigade level. b. Division and higher level staff duty. c. Service school instructor duty. 4/ d. Civilian component duty. 4/ e. Duty with MAAGs and Missions. 4/ f. Attendance at senior service college for selected officers.	Maximum contribution in key command and staff positions at the highest levels through utilization of the officer's professional and technical competence developed through training and duty assignments in earlier periods.
TYPICAL ASSIGNMENTS	BRANCH MATERIAL	COMMAND	Platoon and company/troop command.	Squadron/battalion command (selected officers).	Battalion and brigade command (selected officers). Deputy brigade commander.	Brigade command (selected officers)
		STAFF	Staff duty at battalion, regiment or brigade level. Company/troop executive officer. Training unit officer. Maintenance officer.	Staff duty at brigade, regiment or division level.		
		OTHER	Service school or ROTC instructor duty. Aviation training and unit assignments.	Service school instructor duty.		
	IMMATERIAL	COMMAND	Training unit commander. CO, Special Forces "A" Det. CO, Psychological Operations Unit.	Training unit commander (selected officers). CO, Special Forces "B" or "C" Det. CO, Psychological Operations Battalion.	Brigade command (training) (selected officers). CO, Special Forces Group CO, Civil Affairs Group CO, Psychological Operations Group	
TYPICAL ASSIGNMENTS	BRANCH IMMATERIAL	STAFF	Training unit officer. Special staff duties. Unconventional Warfare Staff Officer. Psychological Warfare Staff Officer.	Staff duty at division or higher level. Unconventional Warfare Staff Officer. Psychological Warfare Staff Officer.	Staff duty at division or higher level (to include DA, joint and combined staffs). Unconventional Warfare Staff Officer. Psychological Warfare Staff Officer. Civil Affairs Staff Officer.	Staff duty at USCONARC, USACDC, DA, DOD, joint or combined staff level.
		OTHER	Civilian component duty (NG, USAR advisor).	Civilian component duty. Duty with MAAGs and Missions. Entrance into special career programs.	Civilian component duty. Duty with MAAGs and Missions. Service school instructor duty. Special career program participation.	Civilian component duty (PMS, NG, USAR senior advisor). Chief of MAAGs or Missions. Special career programs—positions of high responsibility.
YEARS OF SERVICE		(PRECOMMISSION)	1 2 3 4 5 6 7 8	9 10 11 12 13 14 15	16 17 18 19 20 21 22 23	24 25 26 27 28 29 30

Period No. 3, Annex B

JOB SURVEY QUESTIONNAIRE

Name________________________ Rank________ Organization________________

Job Assignment After Completing Armor OAC	Organization	Dates From	Dates To	Training Functions Performed (List Code No.)
1)				
2)				
3)				
4)				
5)				
6)				

(Continue on other side if necessary.)

The following sample may be of assistance in filling out the questionnaire.

Name Gilmore Franklin G. Rank LTC Organization The Armor School General Subjects Dept.

Job Assignments After Completing Armor OAC	Organization	Dates From	To	Training Functions Performed (List Code No.)
1) S-3	84th Tk Bn	May 60	June 61	104, 106, 107, 109, 112, 113, 115, 116, 118, etc., etc.
2) Asst G-3	25th Inf Div	July 61	Dec 62	104, 106, 107, 109, 111, 113, 118, 119, 122, etc., etc.
3) Asst Mil-Attaché	U.S. Embassy Brussels	Jan 63	May 65	None
4) Instr	Armor School	July 65		102, 103, 104, 105, 106, 110, 111, 112, 114, 115, 116, 120, etc., etc.

It is requested that this questionnaire be returned to the U.S. Army Armor Human Research Unit, Fort Knox, Ky.

WILLIAM Q. HARTY
LTC, Armor
Chief

TRAINING FUNCTIONS PERFORMED (Please use code number)

101. Prepared ATP's.
102. Prepared POI's.
103. Prepared Army Subject Schedules.
104. Reviewed ATP's.
105. Reviewed POI's.
106. Reviewed Army Subject Schedules.
107. Interpreted and Explained ATP's.
108. Interpreted and Explained POI's.
109. Interpreted and Explained Army Subject Schedules.
110. Determined and Formulated Training Objectives.
111. Reviewed Training Objectives.
112. Prepared or Modified Lesson Plans.
113. Interpreted and Explained Training Objectives.
114. Wrote Manuscripts Supporting Lesson Plans.
115. Reviewed Manuscripts Supporting Lesson Plans.
116. Reviewed Lesson Plans.
117. Determined Job-Performance Requirements.
118. Reviewed Job-Performance Requirements.
119. Formulated or Helped Formulate Training Policy.
120. Prepared Field Manuals.
121. Prepared Technical Manuals
122. Reviewed Field Manuals.
123. Reviewed Technical Manuals.
124. Determined Requirements for New Equipment Training.
125. Determined Requirement for Training Devices.

201. Prepared Master Training Schedule.
202. Prepared Unit Training Schedule.
203. Conducted Individual Training.
204. Conducted Unit Training.
205. Supervised Individual Training.
206. Supervised Unit Training.
207. Organized Unit School.
208. Directed Unit School.
209. Directed Instructor Group.
210. Prepared OJT Program for Training Replacements.
211. Supervised OJT Program for Training Replacements.
212. Interpreted Training Policies to Subordinates.
213. Obtained and Distributed Training Literature.
214. Interpreted Training Literature to Subordinates.
215. Obtained and Distributed Training Aids.
216. Prepared Training Estimates.
217. Planned Unit or Individual Motivation Procedures.
218. Conducted OJT of Immediate Subordinates.
219. Prepared CPX's.
220. Prepared FTX's.

301. Prepared ATT's.
302. Reviewed ATT's.
303. Conducted ATT's.
304. Evaluated Results of ATT's.
305. Prepared Unit Exercises or Tests.
306. Reviewed Unit Exercises or Tests.
307. Conducted Unit Exercises or Tests.
308. Evaluated Unit Exercises or Tests.
309. Prepared Individual Proficiency Tests.
310. Conducted Individual Proficiency Tests.
311. Evaluated Results of Individual Proficiency Tests.
312. Umpired ATT's, Exercises or Unit Tests.
313. Inspected Training of Own Unit
314. Inspected Training Other Units.

PERIOD NO. 3, ANNEX C

JOB ASSIGNMENTS AND TRAINING FUNCTIONS PERFORMED BY FIFTY AOC GRADUATES - 1956 - 1961

Company C O Probability of Assignment (54%)	202 Prepared Unit Tng Schedule 89%	204 Conducted Unit Tng 89%	205 Supervised Indiv Tng 89%	206 Supervised Unit Tng 85%	313 Inspected Tng of Own Unit 85%	212 Interpreted Tng Policies to Subordinates 81%	203 Conducted Indiv Tng 78%	112 Prepared or Modified Lesson Plans 67%	116 Reviewed Lesson Plans 67%	312 Umpired ATTs, Exercises, or Unit Tests 59%	217 Planned Unit or Indiv Motivation Procedures 48%	307 Conducted Unit Exercises or Tests 48%
Bn C O, X O, S3 Probability (76)	313 Inspected Tng of Own Unit 92%	119 Formulated or Helped Formulate Tng Policy 74%	206 Supervised Unit Tng 71%	111 Reviewed Tng Objectives 63%	205 Supervised Indiv Tng 61%	307 Conducted Unit Exercises or Tests 61%	308 Evaluated Unit Exercises or Tests 58%	312 Umpired ATTs, Exercises or Tests 58%	212 Interpreted Tng Policies to Subordinates 58%	112 Prepared or Modified Lesson Plans 58%	113 Interpreted and Explained Tng Objectives 58%	116 Reviewed Lesson Plans 58%
Armor School Instructor or Chief Probability (60%)	122 Reviewed Field Manuals 70%	105 Reviewed POIs 70%	116 Reviewed Lesson Plans 67%	102 Prepared POIs 63%	112 Prepared or Modified Lesson Plans 60%	114 Wrote MSs Supporting Lesson Plans 53%	115 Reviewed MSs Supporting Lesson Plans 53%	111 Reviewed Tng Objectives 50%	108 Interpreted and Explained POIs 47%	113 Interpreted and Explained Tng Objectives 47%	110 Determined and Formulated Tng Objectives 47%	123 Reviewed Technical Manuals 43%
Instructor ROTC, NG, USAR Probability (46%)	116 Reviewed Lesson Plans 87%	112 Prepared or Modified Lesson Plans 78%	119 Formulated or Helped Formulate Tng Policy 74%	114 Wrote MSs Supporting Lesson Plans 70%	111 Reviewed Tng Objectives 65%	113 Interpreted and Explained Tng Objectives 65%	107 Interpreted and Explained ATPs 61%	115 Reviewed MSs Supporting Lesson Plans 61%	212 Interpreted Tng Policies to Subordinates 57	215 Obtained and Distributed Tng Aids 57%	213 Obtained and Distributed Tng Literature 52%	110 Determined and Formulated Tng Objectives 52%
G-3 Staff Probability (20%)	119 Formulated or Helped Formulate Tng Policy 60%	111 Reviewed Tng Objectives 50%	214 Interpreted Tng Policy to Subordinates 50%	304 Evaluated Results of ATTs 50%	314 Inspected Tng of Other Units 50	104 Reviewed ATPs 40%	106 Reviewed Army Subj Schedules 40	110 Determined and Formulated Tng Objectives 40%	113 Interpreted and Explained Tng Objectives 40	206 Supervised Unit Tng 40%	301 Prepared ATTs 40%	305 Prepared Unit Exercises or Tests 40

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 4

LESSON OUTLINE

INSTRUCTIONAL UNIT: SYSTEMS/DEVELOPMENT AND NATURE

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Mr. Shepard Schwartz

TRAINING AIDS: None

REFERENCES: Sayles, L. R., Managerial Behavior (Published)

ASSIGNMENTS: Read references, Chapter 2

OBJECTIVE: To provide the student with an introductory knowledge of the development and nature of modern systems; and of their typical missions, resources, organization and characteristics

1. THE NATURE OF SYSTEMS

a. Modern systems are the result of historical developments which generated a need for large-scale military, industrial and governmental operations, and for the complex organizations required to perform these operations.

b. The term "system" is popularly applied to such massive organizations as the Army, the Postal Service, mass-production industries, transportation services, etc.

c. As defined by AR 320-5, however, a "system" is "an integrated relationship of components aligned to establish proper functional continuity, towards the successful completion of a defined task or tasks."

d. The concept of "system," therefore, may be legitimately applied to any organization--regardless of size--whose functioning requires the formal integration of its components.

2. SYSTEMS MISSIONS

a. Every system has a definitive mission or missions; and the extent to which it accomplishes its mission constitutes the criterion for evaluating its performance.

b. The "input"-"output" concept is especially useful in describing a system's mission, and in evaluating its performance.

3. SYSTEMS ORGANIZATION

a. Every large system is organized into an integrated complex of sub-systems.

b. Each sub-system has its own organization, and its own definitive mission, i.e., to perform or to support the performance of some element of the main system mission.

c. Every large system has major sub-systems responsible for policy making, management, and operations; and virtually all, major sub-systems for distribution, planning, materiel procurement, personnel procurement, and training, etc.

d. Every sub-system interacts directly with other sub-systems; those normally include the sub-systems immediately above it, or below it, in the system hierarchy; those sub-systems which it supports, or which support it; and those to whom it reports --or which report to it--for coordination purposes.

4. SYSTEMS RESOURCES

For practical purposes, any "sub-system" may be regarded as a "system." Every system--and sub-system--is provided with the resources deemed necessary to accomplish its mission; those resources typically consist of men, machines, materials, methods, plant-space, and time.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 5

LESSON OUTLINE

INSTRUCTIONAL UNIT: SYSTEMS/ILLUSTRATION OF MODERN INDUSTRIAL SYSTEM

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Mr. Shepard Schwartz

TRAINING AIDS: None

REFERENCES: Rapoport, R., Life On The Line (Published)
Sayles, L. R., Managerial Behavior (Published)

ASSIGNMENTS: Study Rapoport; Read Sayles, Chapter 14

OBJECTIVE: To provide the student with an illustration of a modern industrial system and to identify the missions, resources, organization and characteristics of the system and its sub-systems

The discussion is based chiefly on the Rapoport article, and on Sayles, Chapter 14. Students are encouraged to provide questions and observations. The following list of questions and answers illustrates the kind of topics that should be touched on in relating the Rapoport example to the process of identifying system missions, resources, organization, etc.

1. The main assembly line described is a sub-system in the Wixom plant, which is--in turn--a sub-system of the Ford "production" sub-system.

2. The main assembly line embraces about 60 sub-systems (stations).

3. What are the missions (approximate) of: a) the Ford Company; b) the production sub-system; c) the Wixom plant; d) the main line; e) any of the stations described?

a. To manufacture and sell automobiles at a profit.

b. To produce automobiles of a specified type, at a specified rate, of a specified standard, for shipment to dealers.

c. To manufacture parts, sub-assemblies, components (or obtain them from suppliers) and to assemble into automobiles of specified types, etc., to be delivered to "final inspection."

d. To install engine into engine compartment and secure with bolts; to attach

steering column, fenders, etc.

c. To feed meals to 2700 people at specified intervals, etc.

4. What resources are utilized at the stations described?

a. Assemblymen (3 - 4?); foreman (1); plus one line-inspector (1st echelon repairs) per three stations.

b. Machines and tools; the line itself; cranes; conveyors; power wrenches, etc.

c. Materials: finished, standardized parts and components, plus bolts, nuts, etc.

5. Describe management on the main line.

Foremen and supervisors appear to function more as senior operatives, inspectors, repairmen and "stand-ins" than as managers.

6. Describe the information system on the main line.

Hand-signals and gestures are used. Errors are "tagged." Noise-level is high, and the system--optimally--should function with minimal communication. It appears that the conveyor system is "computer-programmed," so there is no need to inform the line that "every twelfth car is a blue sedan with six-cylinder engine, etc."

7. Describe the quality-control system.

Line inspectors and foremen search for errors, and make first-echelon repairs. (They "tag" errors if not repaired.) Final inspectors repeat this process, and branch "rejects" to repair shop.

8. Describe the "recruiting system" and the "training system."

a. Fairly intensive physical examination: Health? Strength? Perception? Coordination? But no test for color-blindness. Twelve-item intelligence test.

b. Minimal training for the job. Casual illustration and instruction by Clyde and other workers.

9. Give an example of insufficient rationalization (getting waste out of the system).

Horseplay and concerts, defective kickplates.

10. Give examples of over-rationalization.

a. No place to rest during break.

b. Crowded cafeteria (probably because line has been stopped for maintenance).

11. Give an example of the interactive effect of system error.

Badly installed steering column prevents subsequent operations.

12. Is the writer correct in his conclusion that error on the assembly line leads to the consumer getting a defective car?

Probably not. The line seems to be designed to produce about 80 - 85% "satisfactory" cars, with the remainder branched to the repair shop for second and higher echelon maintenance. What would it cost to get the rate to 95% satisfactory? 100%

13. Discuss Sayles' comments on "dual allegiance" of the manager in industrial and other systems (Page 29) with the Army's emphasis on unitary command.

14. Discuss Sayles' comments on "maximization" (Chapter 14) and the role of the manager. Does the system permit unilateral changes, the great year, the burst of productivity? What is likely to happen if changes are made within a system without considering their impact on the rest of the system?

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 6

LESSON OUTLINE

INSTRUCTIONAL UNIT: SYSTEMS/MILITARY MANAGEMENT

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Mr. Shepard Schwartz

TRAINING AIDS: None

REFERENCES: AR 1-24: Army Management Doctrine (Published);
Milton, H. M., Management In The Army (Published)

ASSIGNMENTS: Read AR 1-24; Read Milton

OBJECTIVE: To provide the student with a knowledge of the major practices and problems of military management, and of the implications of the systems concept on military management

1. This hour consisted of a free-floating discussion of eight management principles or problems that have special application to military management. Six of these problems are described in AR 1-24, and are re-stated and developed in Under-Secretary Milton's lecture. In addition, two hypotheses advanced by Sayles--that the systems concept requires: a) re-definition of the manager's role; and b) the elimination of "unitary command"--were also presented for discussion.

2. It was intended that the students generate the illustrations, judgments, and arguments pro and con the principles advanced. The detailed objectives for the hour, therefore, consisted only of providing the student with: a) a knowledge of the kinds of problems that are of current concern in military management, and b) definitions of these problems and of the terms relating to them.

3. The following definitions were utilized:

a. Management: . . . the continuing actions of planning, organizing, directing, coordinating, controlling and evaluating the use of men, machines, money and materials in order to accomplish missions and tasks. (Milton)

b. Command: The authority and responsibility for effectively using available resources, and for planning the employment of, organizing, directing and controlling military forces for the accomplishment of assigned missions. (Milton)

c. Doctrine: Fundamental principle by which the military forces . . . guide their actions in support of national objectives. It is authoritative but requires judgment in application.

d. Service organizations: . . . an organization the primary function of which is to render noncombat support to other organizations. All activities of a unit or command other than combat. (Milton)

e. Centralization: The systematic and consistent reservation of authority at centralized points within the organization. (Milton)

f. Decentralization: Systematic delegation of authority in an organization-wide context. (Milton)

g. Management by exception: Concentration of management effort upon changes from previously known situations; upon deviations from norms; and upon problems commensurate with levels of responsibility. (AR 1-24)

h. Management and Operating improvement: The responsibility of management for continual improvement of systems, methods, use of resources, etc. (AR 1-24)

i. Communication: The effective exchange of information between units or individuals. Effective understanding is facilitated by universal usage of terms, clear and freely used channels of communication, and mutual knowledge of objectives, priorities and standards of performance, between superiors and subordinates. (AR 1-24)

j. Human Relations: The utilization and motivation of subordinates by means that are effective, moral and consistent with human dignity.

k. Motivation: Creating a situation in which members of a group can satisfy their individual needs while at the same time working towards the goals of the organization.

4. Invite or initiate discussion of Sayles' conclusion that in modern system organizations "unitary command is impossible" and the manager functions as a broker and "trade-off specialist" who keeps his own sub-system operating by negotiating with higher management, with the sub-system that "feeds" it, the sub-system it "feeds," and the sub-systems that support it.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 7

LESSON OUTLINE

INSTRUCTIONAL UNIT: SYSTEMS/THE ARMY SYSTEM

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Norman Willard

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

OBJECTIVE: To demonstrate to the student the systemic nature of the Army as an organization, and to identify the commands and other agencies that constitute major sub-systems in performing such functions as policy-making, management, planning, supply, transportation, personnel procurement, information services, research, development, training, etc.

1. GENERAL DISCUSSION

a. The Army is organized and functions as a system. It is composed of a large number of major sub-systems, and a multitude of progressively smaller sub-systems down to the smallest units and the men who comprise them (the squad, the tank crew, the mess hall).

b. The Army, in turn, is a sub-system of the Defense Department and the National Government, and its funds and high-level policy are provided and controlled by these organizations.

c. Among the major Army sub-systems is an information system which prescribes the form, content, frequency, etc., of directives and reports.

d. A substantial part of the directives and reports communicated through the Army information system are utilized to provide control over the quality of operations and "operational readiness."

e. The Army information system maintains a massive literature supply--in the form of ARs, FMs, TMs, etc.--for the purpose of describing for virtually all of its sub-systems, units, and individuals, their mission and job responsibilities, performance standards and methods to be employed.

2. IDENTIFICATION OF SUB-SYSTEM FUNCTIONS

a. Policy Making. High-level policy is made by Executive, Congress, DOD, D/A. But policy-making occurs at every level of command.

b. Management. D/A--Chief of Staff through chain of command.

c. Funding. Congress, DOD, D/A, Comptroller.

d. Planning. D/A, ACSFOR, DCSOPS, DCSPER, DCSLOG, CDC, AMC, R&D.

e. Operations. DCSOPS, Field Armies.

f. Materiel. DCSLOG, AMC.

g. Personnel. DCSPER, OPO.

h. Transportation. DCSLOG.

i. Information Services. D/A, Communications Command. CONARC--through its Service Schools--prepares directives, ATPs, POIs, FMs, TMs, etc. D/A prepares ARs. AGO prints, distributes and controls literature. Field Armies publish circulars, etc.

j. Research. R&D.

k. Development. ACSFOR, CDC, AMC, R&D.

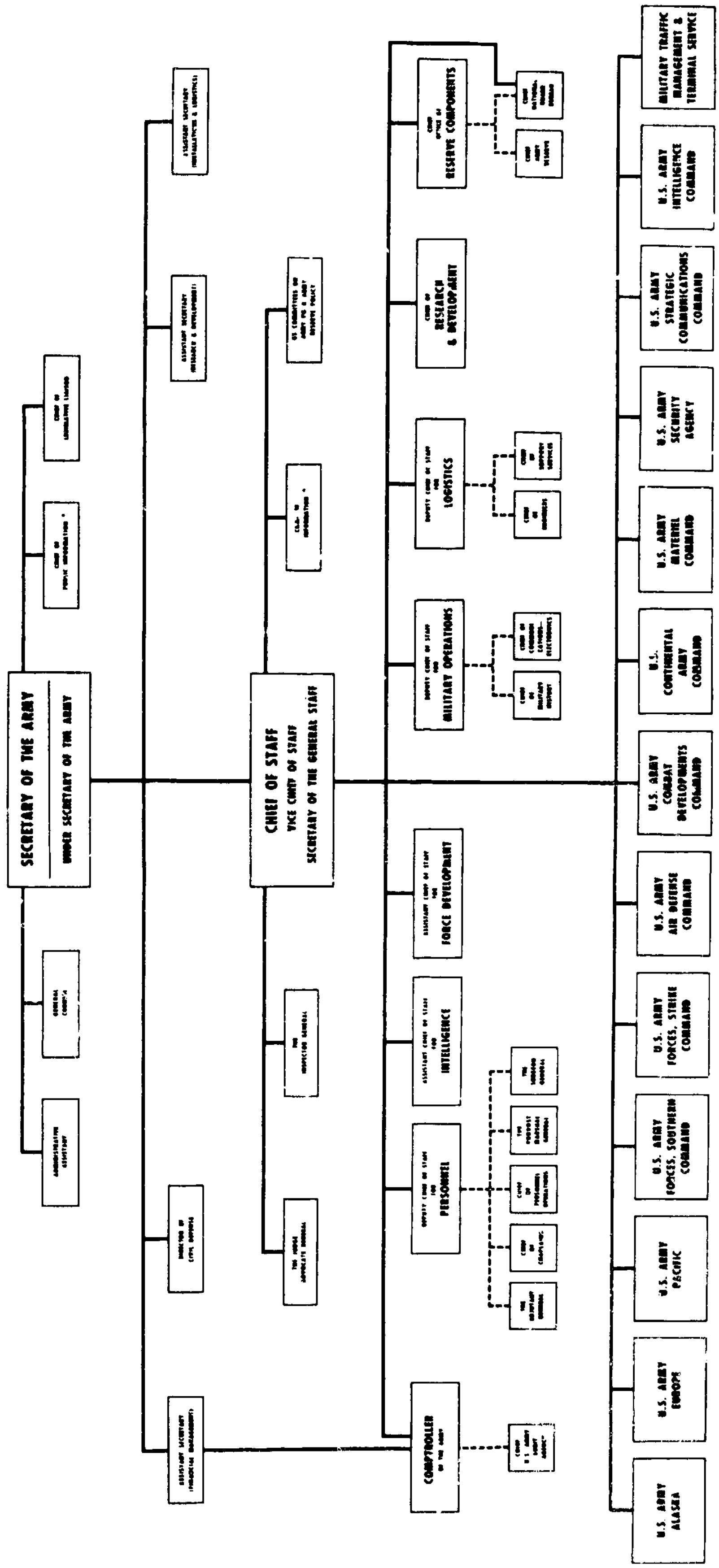
l. Quality Control.

(1) Materiel. AMC, TECOM, Army Boards

(2) Units and Individuals. CONARC, Field Armies, AG through AGIs and enlisted evaluation tests: CMIs, OERs, ATTs

m. Training. CONARC through Training Centers, Schools, Training Literature; Field Armies through Training Centers and Schools. Unit Commands. On-job-training Army-wide commander responsibility.

ORGANIZATION OF THE DEPARTMENT OF THE ARMY



HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 8

LESSON OUTLINE

INSTRUCTIONAL UNIT: SYSTEMS/ARMY PERSONNEL AND TRAINING SUB-SYSTEMS

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Mr. William Osborn, Dr. Norman Willard

TRAINING AIDS: None

REFERENCES: Baker, R. A., The Army's Training Mission (see Readings)
Osborn, W. C., Elements of Personnel Selection (see Readings)

ASSIGNMENTS: Read references.

OBJECTIVE: Student must be able to list functions performed by both the personnel and training sub-systems and to describe the interrelationship between them

1. INTERFACES BETWEEN PERSONNEL SELECTION AND TRAINING

a. Selection determines ability level of trainee.
   (1) Training requirements change as selection standards change
   (2) Training methods adapted to ability level
b. Job objectives met through selection or training.
   (1) Selection of pretrained personnel
   (2) Job aids may lower selection demands
c. Performance in training may be used as criterion for selection.
d. Performance early in training used to predict successful completion of training or later success on job.

2. PERSONNEL-SYSTEMS APPROACH TO A TRAINING PROBLEM

a. Possible training solutions.
   (1) Better instructional techniques
   (2) Revise course content
   (3) Extend training time
b. Possible solutions through personnel selection.
   (1) Determine correlates of trainee failure or improve existing prediction
   (2) Increase selection ratio
c. Possible solutions through human engineering: modify equipment or work

environment; e.g., use of job aids to simplify job--thus lowering training and selection requirements.

3. GOAL: To identify least costly solution.

4. THE ARMY TRAINING SYSTEM: Requirements, planning, conduct, quality control.

5. RESPONSIBILITIES FOR TRAINING REQUIREMENTS

   a. ACSFOR.
   b. CDC.
   c. AMC.
   d. DCSPER.
   e. OPO.

6. RESPONSIBILITIES FOR TRAINING PLANNING

   a. AMC--Civilian contractors.
   b. CONARC.
   c. Field Armies.

7. RESPONSIBILITIES FOR CONDUCTING TRAINING

   a. Commodity Commands--Contractors.
   b. CONARC.
   c. Field Armies.

8. QUALITY CONTROL OF TRAINING

   a. ATTs.
   b. QMIIs.
   c. AGIs.
   d. Service school follow-up of graduates.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 9

LESSON OUTLINE

INSTRUCTIONAL UNIT: SYSTEMS/SYSTEM ANALYSIS AND COST EFFECTIVENESS

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Mr. Shepard Schwartz

TRAINING AIDS: None

REFERENCES: Hayes, J. H., Systems Analysis (Published)
Pfeiffer, J., New Look At Education (Published)
Quade, E. S., Cost Effectiveness: Introduction and Overview (Published)

ASSIGNMENTS: Read Hayes; Read Pfeiffer, Chapter 2; Read Quade

OBJECTIVE: To provide the student with a knowledge of the general nature, purpose and procedures of systems analysis/cost-effectiveness studies, so that he will be able to recognize appropriate applications of systems analysis procedures to military decision-making problems

1. "Systems Analysis," as defined by AR 320-5, is "the study of a system--by means of ordered procedures and techniques--in order to evaluate the effectiveness with which the system's missions are accomplished, and to recommend improvements."

2. The concepts, procedures and techniques employed in systems analysis were developed principally in industrial engineering, operations research, and management theory. In recent years, systems analysis has been applied to transportation systems, medical/hospital services, education, and other fields.

3. Systems Analysis (like training-systems analysis) is applicable both to systems "in being" and to those "on the drawing board." Period No. 10 will consist of a discussion of TSA versus the R&D cycle.

4. Systems Analysis is still in a relatively formative stage, and does not have a sufficient theoretical groundwork to be regarded as a "science." (See Quade)

5. However, there is general agreement on the nature of the operational steps involved in analyzing a system. (Compare Quade's five steps with Pfeiffer's eight steps.)

6. The steps employed in systems analysis are: (See Pfeiffer, Chapter 2)

a. Defining the problem.
(1) The objective or objectives (What is the Army's mission--Project 100,000 as an example of expanded or changing objectives)
(2) Criterion measures of effectiveness
(3) Constraints (laws, policies, etc.)
(4) Uncontrollable variables (weather)
(5) Controllable variables (system resources)

b. Defining sub-functions. (What performances--man or machine--are required to accomplish the objectives?)

c. Define alternatives for performing each sub-function.

d. Synthesizing the sub-systems (selecting "mixes" of alternatives).

e. Developing the model (Troop test, service test, proficiency test, computer, etc.).

f. Collecting data.

g. Evaluating the results.

h. Selecting the produce (cost-effectiveness).

7. The steps involved in cost-effectiveness decision-making are:

a. Defining the objective or objectives.

b. Listing the alternatives.

c. Evaluating the costs of each alternative (real costs).

d. Using a model to evaluate the extent to which each alternative contributes to system objective.

e. Using a criterion or standard to rank alternatives on cost and effectiveness.

8. The process is essentially repetitive (see Pfeiffer, Page 32), and involves re-examination of assumptions about objectives, constraints, alternatives, etc. (trade-off).

9. Discuss the virtues and limitations of systems analysis as described by Quade.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 10

LESSON OUTLINE

INSTRUCTIONAL UNIT: SYSTEMS/MATERIEL AND TRAINING R&D CYCLES

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)
Annex B (one per student)

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: Crawford, M. P., HumRRO Techniques In Course Development (Published)

ASSIGNMENTS: Study references, pp. 4-10

OBJECTIVE: Student must know the steps in the hardware and man development cycles, the principal agencies responsible for each step, and the relations of the two cycles in training analysis

1. SYSTEMS

Have been discussing concepts of system, system management and system analysis.

a. System is a set of functions related by a common goal.

b. Sub-systems of Army systems often include man-machine sub-system which, in turn, specifies requirements of the relevant training sub-system.

c. One requirement of training sub-system analysis is specification of the goals and functions pertinent to the man-machine sub-system.

d. Second requirement of training sub-system analysis is specification of the goals and functions interrelating all of the personnel sub-systems interacting to attain the system goal.

2. HARDWARE R&D CYCLE

Prototype six year cycle with interaction primarily of CDC, AMC and USCONARC.

a. CDC--Qualitative Materiel Development Objective and Qualitative Materiel Requirement stating the goals for the man-machine system necessary to fulfill tactical requirements of meeting anticipated threat.

b. AMC--Develop machine sub-system through Commodity Commands, test machine effectiveness in meeting QMR goals (TECOM).

c. USCONARC--Test man-machine system effectiveness in meeting goals where man sub-system represents anticipated selection, training and experience levels for machine utilization by the Army.

3. MAN R&D CYCLE

Time requirements specified mainly by cost of modifications and time for development of man sub-systems. Interaction of responsible Army agencies with human factors agencies.

a. Human Engineering Laboratory--Man-machine compatability, must be performed early in the hardware cycle to minimize costs of hardware change.

b. Behavioral Science Research Laboratory--Personnel selection requirements, necessary before training requirements can be established, also need early in hardware cycle to determine possible man-machine function allocation trade-offs.

c. Human Resources Research Office--Training methods and training device requirements, training device requirements must be specified approximately three years before initiation of resident training.

4. HUMAN FACTORS DATA BASE (Annex A)

Required for all human factors analysis.

a. System Standards and Conditions--Based on QMDO and QMR, consists of mission definition to state functions of man-machine system, mission narrative to provide function interaction and system standards under anticipated mission conditions, results in statements of quantitative man-machine system standards for each function and under each mission condition, also designates appropriate machine standards.

b. Man-Machine Functional Procedures--Based on hardware design and mission narrative, begins with man task inventory from equipment analysis, step descriptions provide input-response-output for each task, tasks are then integrated into mission procedures for each function.

c. Human Performance Requirements--Integrate procedures, conditions and calculated human requirement that, when combined with machine requirement, will yield system standard; provides basis for human factors analysis and standardized testing during that analysis.

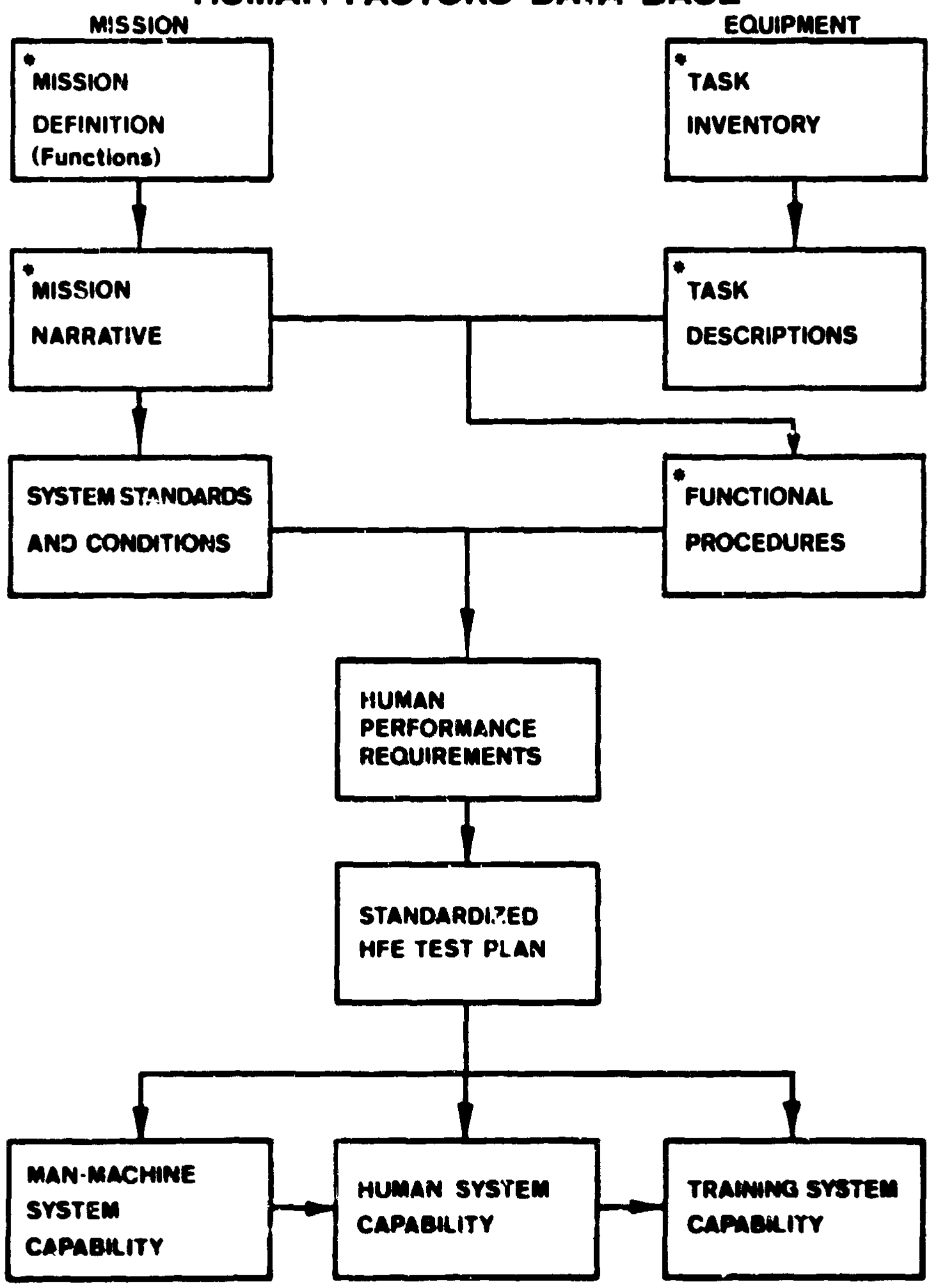
5. INTEGRATED MAN-MACHINE DEVELOPMENT (Annex B)

Must consider data requirements for succeeding steps, timing for tested resident training program, and feed-back of results into equipment cycle. Same requirements for analysis of an on-going training program without timing and feed-back limitations.

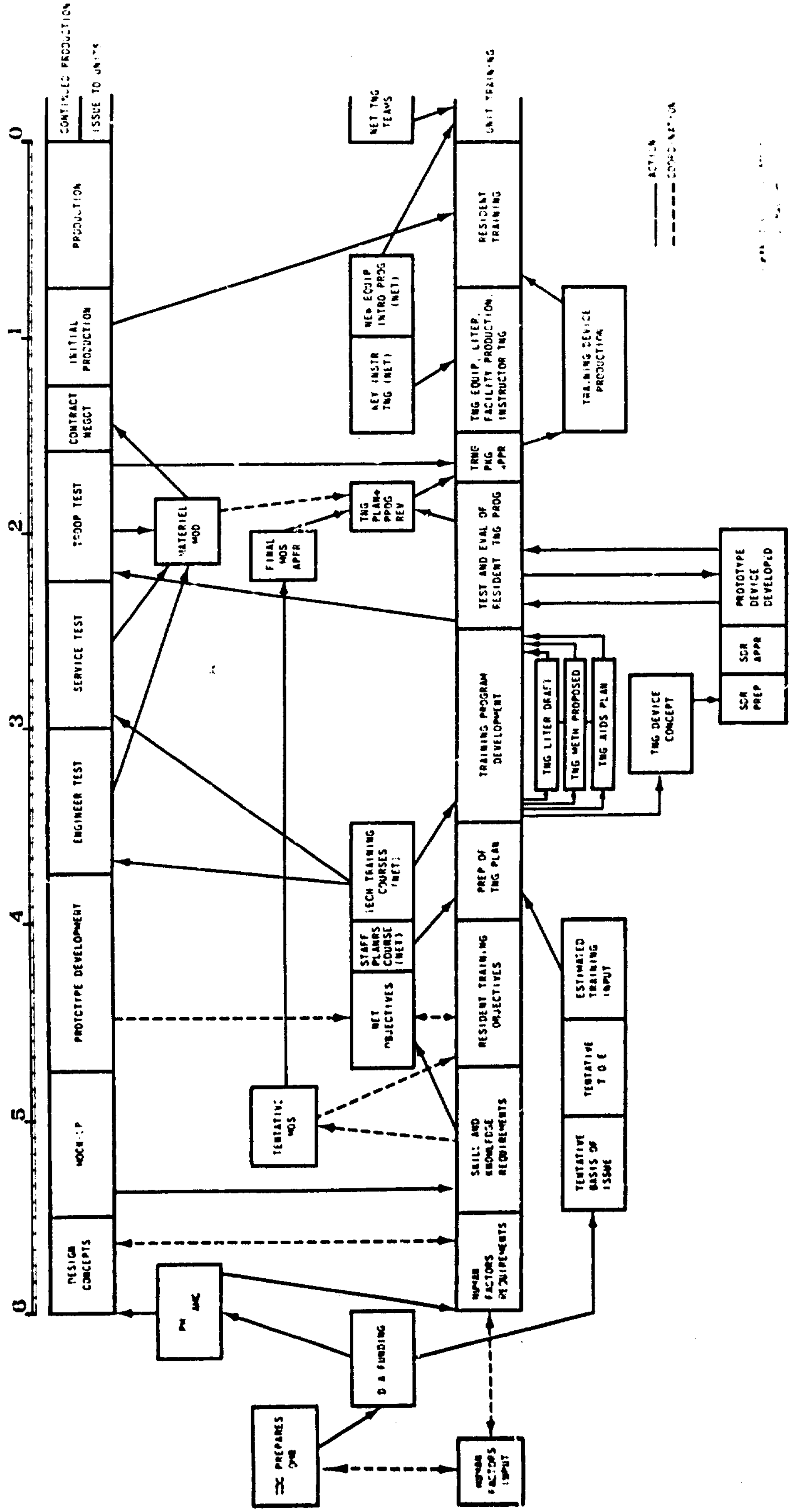
6. COURSE OUTLINE

Follows proposed phasing through test and evaluation.

HUMAN FACTORS DATA BASE



Proposed Phasing of Training Program Development and Materiel Development Activities



HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 11

LESSON OUTLINE

INSTRUCTIONAL UNIT: SYSTEMS/SUB-SYSTEM ANALYSIS

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Mr. Shepard Schwartz

TRAINING AIDS: None

REFERENCES: Department of the Army, The Tank Gunner's Guide (Tank, 90-MM Gun, M48A1) (Published)

ASSIGNMENTS: Read references

OBJECTIVE: To provide the student with a demonstration of the general procedures for analyzing a small sub-system in order to establish the "setting" in which a particular job in that sub-system is performed

1. Inform class that its mission is to study the training of the tank gunner, and to perform Step 1 of the seven steps.

2. Review the relation of Step 1 to Step 2.

3. The tank crew as a system.

a. Composition of the crew.
b. Position in the larger system (operates as part of five-tank platoon, under command and control of a platoon leader).
c. Crew missions.
(1) Maintains its tank, weapons, etc., and prepares them for tactical use.
(2) Operates tank under tactical conditions on: reconnaissance, attack, defense and retrograde missions.
(3) Trains AIT, BUT, AUT.

4. Duties of Individual Crew Members.

a. Tank Commander: Issues commands and other directives (relays from platoon leader); supervises crewmen as they perform their duties; trains crew, both as unit and individuals; performs some operative functions (maintains Cal. 50, ranges, searches).

b. Gunner:

(1) Maintains main gun, weekly
(2) Maintains direct fire sights
(3) Maintains main gun before firing
(4) Checks tank instruments
(5) Searches for and reports targets and other battlefield information
(6) Fires main gun and Cal. 30
(7) Maintains main gun after firing
(8) Prepares and fires from a range card

c. Driver: Maintains track, suspension system, auxiliary, etc.; searches to direct front and reports; drives tank; positions tank for firing, etc.

d. Loader: Maintains Cal. 30, radio, etc.; stows ammunition; searches to left flank; loads main gun and Cal. 30, etc.

5. Interactive duties.

a. Since much of the crew's behavior is triggered by the commands of the Tank Commander, there is a kind of continual interaction between the TC and the crewmen.

b. Some duties require direct linked interaction between two or more crewmen, viz., firing main gun; firing Cal. 30; boresighting.

c. Many duties (most) require interaction between individual and machines, instruments, meters, etc.

6. The crew information system. Intercom and face-to-face conversation provide the media. Crew must know the specific meaning of commands and other cues, in terms of required behavior.

7. The Crew Training System. Emphasis is on unit training, but individual training is also conducted as OJT. For purposes of defining training objectives in Step 5, it will be valuable to consider this OJT, the close supervision provided by the TC of crewmen, and the normal career progression of the gunner into the TC slot.

8. For purposes of performing Step 1, the analysis is pretty much confined to describing objectives, constraints, measures of system effectiveness and sub-functions.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 12

LESSON OUTLINE

INSTRUCTIONAL UNIT: SYSTEMS/STUDENT EXAMINATION AND REVIEW

TYPE: Conference, examination

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Mr. Shepard Schwartz

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

Period No. 12, Annex A

SYSTEMS/STUDENT EXAMINATION

NAME________________________________

Answer Items 1 and 2.

1. Discuss the inter- and intra-dependencies of components and component functions within a system. Use a line company as a military example.

2. List the normally required system functions (e.g., planning, production, quality control, etc.), and show how these parallel the Army equipment R&D cycle and the suggested steps in training development.

Answer one question from each of the following pairs.

3. Identify and describe five high-probability future assignments for Career Course graduates which require training management skills.

4. List five factors in military management described in Milton's article, "Management in the Army." Discuss one of these factors.

5. Discuss Sayles' point on "dualism" as opposed to "unitary command" as it applies to managers in military organizations.

6. Discuss each of Quade's five activities in military systems analysis.

7. List the normally required system functions and describe the Army agencies or commands charged with each of these functions.

8. Give an example of a cost-effectiveness problem that is relevant to one of the steps in training development. You don't have to solve the problem, but you should identify: a) the action alternatives, b) the training costs and gains, c) the "yardstick" for each source of payoff (cost or gain), and d) the decision rule.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 13

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/MISSION REQUIREMENTS

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: McKnight, A. J., Establishing Performance Requirements (see Readings)

ASSIGNMENTS: Study references, pp. 1-11

OBJECTIVE: The student must be able to analyze (either orally or in writing) a training system, determine the training mission, and derive the critical human performance requirements to the satisfaction of the instructor

1. A sound training program is always based on a thorough understanding of the system, i.e., an Analysis of System.

2. To analyze a system means to take the various operations making it up, and then studying their interrelationships. Analyze:

   a. The mission.
   b. The environment.
   c. System components, i.e., men and materiel.

3. For training purposes, we have focused on the man to be trained.

4. To design a training program, we have to see how the individual interacts with other system components, and we have to study all aspects of the system to see what does and what does not have a bearing on job performance.

5. Where do you look? One must be a good detective.

6. A good place to begin is with the Mission or Missions of the system.

7. What is the mission, what are the standards of mission performance, and what are the operations required to complete the mission?

8. Where does mission information come from?

a. Official Doctrine--FMs, ARs, TMs, CDC.
b. System Design Data--QMRs, Logistics and Maintenance Support Plans, Contractor Proposals.
c. Experience--Field surveys, questionnaires, interviews.

9. Identifying mission operations is the first step in the long process of finding, identifying, and analyzing jobs, duties, and tasks. In doing this, we must consider:

a. Operations.
b. Performance Standards.
c. Skills and Knowledges.
d. Physical Requirements.
e. Critical Time--Relationships.
f. Discrete or Continuous Tasks.
(1) Example:
Running a Maintenance Depot   Flight NY to Paris and return

10. What is a flow chart or flow diagram?

11. What is a function?

Answer: Activities that share the same underlying skills and knowledges, e.g., flying bombers and light planes, navigating, electrical signal tracing. You should try to identify as many functions as possible to insure that critical and important activities won't be overlooked.

12. In large military hardware systems, the responsibility for analyzing missions usually falls upon the developmental contractor.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 14

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/MISSION PERFORMANCE STANDARDS

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: McKnight, A. J., Establishing Performance Requirements (ses Readings)

ASSIGNMENTS: Study references, pp. 11-18

OBJECTIVE: The student must be able to explain (either orally or in writing) the relationship between mission performance standards and human performance standards, and describe the influence of the various environmental factors upon human performance

1. As missions and operations are analyzed, it becomes necessary to assign standards of:

a. speed,
b. accuracy,
c. reliability,

to each subordinate level of mission performance.

2. It is unrealistic to set absolute standards of human performance, since humans differ so widely; so we set relative standards. Of course, everybody wants a first round hit at 2000 yards in 8 seconds, but we find we have to trade-off, i.e., is speed more important than accuracy? Fast but error-filled? Slow but sure?

3. Trade-off among operations. Which of several operations demands the most reliable performance? If we know, then we can spend training time where it will do the most good. But what are some of the more important determiners of standards?

4. Speed. How quickly an operation must be performed will depend on:

a. Absolute speed requirements--Hand grenades--5 seconds--BOOM.

b. Criticality--Missile malfunctions must be corrected immediately. Organization Maintenance faster than Support Maintenance.

c. Scheduling--Less urgent, do now.

d. Termination time--Can it be stopped immediately if an emergency comes up (e.g., tank engine disassembly)?

e. Frequency of use--If used every day, then it should be done faster (memory) than something done only one time yearly.

5. Accuracy will be influenced by design tolerances and critical levels of equipment functions.

a. Cumulative effects--i.e., Navigational errors require greater accuracy without check points than with.

b. Errors. Random or consistent bias--A method which has a consistent bias will lead to greater and greater inaccuracy.

6. Reliability.

a. Criticality to mission--Failure to file a flight plan less serious than to fill gas tank.

b. Safety--Maintenance more important in aircraft maintenance than in surface vehicles.

c. Error detection--Tracking errors--immediate; navigational--later.

d. Reversability--i.e., can the error, if detected, be corrected before damage is done?

7. In the Analysis of the System Environment, look for environmental factors that:

a. Create tasks--Cold weather.
b. Determine when a task will be done--Night.
c. How task will be performed--Navigate in rain and fog, or on clear day.
d. Knowledge of skill requirement--Driving on ice.

Environmental Factors:

Illumination
Terrain
Weather
Noise and Vibration
Enemy presence--radio silence
System failures

Sources of Information:

Doctrine
Field Surveys
Geological and Meteorological Surveys
"Environmental Envelope"

8. Methods of Analysis. No "one best" method. Explain the Environmental Overlay or Mission Overlay.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 15

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/HUMAN PERFORMANCE REQUIREMENTS

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: McKnight, A. J., Establishing Performance Requirements (see Readings)

ASSIGNMENTS: Study references, pp. 18-26

OBJECTIVE: The student must be able to state (either orally or in writing) those items making up "materiel" and the procedures usually followed in analyzing the system components. The student must be able to distinguish "man-ascendant" systems form "machine-ascendant" systems and to list those functions "best" performed by equipment and those functions "best" performed by human beings

1. ANALYSIS OF SYSTEM COMPONENTS

a. Interactions of the individual job performer with all other personnel and items of materiel.

b. Allocation of functions to various components of the system so that functions left to the individual to be trained in are sound.

2. MATERIEL. What is materiel?

a. Equipment (Tactical--rifles, tanks)
(Support--tools, trucks, computers).
b. Supplies--ammunition, spare parts.
c. Protective materials--gas masks, clothing.
d. Printed job aids--TMs, charts, audio/visual.
e. Facilities--buildings, work tables, desks.

3. MATERIEL ANALYSIS

a. Primary equipment.
b. Auxiliary equipment.
c. Printed materials.
d. Maintenance allocation charts.
e. MEADS--"task element."

4. MAN-MACHINE FUNCTION ALLOCATION

a. Vehicle control--manual or semi-automatic.
b. What are human beings "good" at? What are machines "good" at?
   (1) Functioning under overload--man
   (2) Routine monitoring--machines
   (3) Selecting inputs--man
   (4) Generalizing--man
   (5) Repetitive tasks--machines
   Etc.

5. JOB AIDS

a. Head versus hand?
   (1) Rarely used --Manual or job aid
   (2) Volume --Manual or job aid
   (3) Problem solving --Manual or job aid
   (4) High reliability needed--Manual or job aid

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 16

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/ALLOCATION OF HUMAN PERFORMANCE REQUIREMENTS

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: McKnight, A. J., Establishing Performance Requirements (see Readings)

ASSIGNMENTS: Study references, pp. 26-30

OBJECTIVE: The student must be able to demonstrate, in the classroom discussion, his knowledge of the methods and procedures commonly used in performing the personnel analysis portion of a Systems Component Analysis

1. MAN OR PERSONNEL ANALYSIS

Tasks must be analyzed in detail before allocations are made.
Where does one get the necessary information?
Answer: TOEs, TDs, AR 611-201, the MOS Specification Regulation, etc.

2. WHAT IS ANALYZED?

a. Skills and knowledges.
b. Work load.
c. Movement.
d. Classification or grouping tasks.
e. Task allocation--examine several jobs at once.

3. SKILL COMMUNALITY (i.e., functions)

Task dependence and interdependence. Sequence is also important. So is available work space.

4. MOS BREADTH

The more duties within a given MOS, the more time it takes to train. Therefore, should we specialize or train broadly? (Note: Specialization is uneconomical from a personnel management viewpoint.)

5. VERTICAL ALIGNMENT OF MOS AND ALLOCATION OF TASKS TO SKILL LEVELS

Not efficient to train everyone (draftees and career soldiers alike) to the same levels--not when 80% leave the Army at close of their first enlistment. (Note: Restrict costliest training to career soldiers.)

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 17

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/APPLICATION OF SYSTEM MISSION ANALYSIS

TYPE: Lecture, practical exercise

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

OBJECTIVE: The student must be able to perform, in writing, a mission, environment, and systems components analysis of a new "prototypic" weapons sytem. This analysis should include (1) a mission analysis, (2) the mission operations, (3) the mission performance standards in terms of speed, accuracy, and reliability, (4) an environmental analysis, and (5) an analysis of the systems components including a materiel analysis, man-machine function allocations, and a personnel analysis

1 SYSTEMS ANALYSIS

To analyze a system means to reduce that system to the various operations that make it up, and study the relations among these operations.

We are doing this for one purpose--The Training Program. What are the HPRs?

Identity the <u>missions</u> the system is supposed to perform.

Information about the mission comes from:

a. Official Doctrine--FMs, ARs.
b. System Design Data--QMRs.
c. Experience.

2. MISSION ANALYSIS

In mission analysis, we look at:

a. The mission operations--nature and frequency of mission functions, flow charts, discrete and continuous.

b. Standards--speed, accuracy, reliability, criticality, frequency, tolerance levels, safety.

c. Analysis of Environment:
   (1) Create tasks--e.g., Cold weather
   (2) When task performed--Daylight
   (3) How task performed--Fog on navigation

d. Other environmental factors:
   (1) Illumination--Recon, day and night
   (2) Terrain--Mountains and swamps and tanks
   (3) Weather--Wind, rain, fog--Landing an airplane
   (4) Noise and vibration--Need for hand signals
   (5) Enemy--Radio silence
   (6) System failures--Radio failure on navigation

3. ANALYSIS OF SYSTEM COMPONENTS

a. Men.

b. Materiel--Where does information about this come from? CDOG, QMR, TD plans, contractor proposals.

c. Allocation of jobs to men and machines.

d. Man-ascendant versus machine-ascendant systems.

4. MATERIEL ANALYSIS

a. Prime equipment, auxiliary equipment, printed materials.

b. Man-machine function allocation.

c. Job Aids--How decide:
   (1) Frequency of use--rare; Volume--if large
   (2) Problem solving--Firing tables--nomenclature
   (3) Reliability--Pre-flight checklist

5. MAN (PERSONNEL) ANALYSIS

Analyze tasks in detail before allocating:

a. Skills and knowledges.

b. Work loads.

c. MOS problem

Train everyone to same level (vertical problem) when 80% leave after first enlistment?

MOS specialization versus breadth.

(Note: Training manager's job to see that tasks are properly allocated.)

6. PRACTICAL EXERCISE

Give examples of man and materiel ascendant systems:

a. Combat--missile, rifle squad.
b. Intelligence--U2 aircraft recon, patrol.
c. Transportation--air transport, APC.
d. Communication--Seventh Army communication system, field radio.
e. Personnel support--computer, medical unit.
f. Materiel support--maintenance depot, company supply.

7. AIR CUSHION VEHICLE

Students must analyze and complete the following outline based on Annex A:

a. Mission analysis.
b. Mission operations.
c. Establish Mission Performance Standards:
   (1) Speed, Accuracy, Reliability
d. Environment analysis.
e. Systems Components Analysis.
   (1) Materiel analysis
   (2) Man-machine function allocation
   (3) Personnel analysis

Period No. 17, Annex A

THE AIR CUSHION VEHICLE

A. BACKGROUND INFORMATION

1. The Vehicle

a. The vehicle is an "air cushion vehicle" (also known as a Ground Effect Machine or Hovercraft). The vehicle rides on a cushion of air generated by large fans and is propelled by ordinary aircraft propellers.

b. This vehicle is currently in use as a patrol vehicle as well as an amphibious assault craft. It has been used commercially between Oakland and San Francisco Airports in the United States as well as across the English Channel. The Army plans to procure ACVs for use as an armed combat, reconnaissance and transport vehicle. The ACV will be assigned to an Armor unit.

c. Speed. The ACV can operate at speeds of from one to sixty miles per hour.

(1) Over water speeds below 15 miles per hour are inefficient because (a) the vehicle becomes enveloped in its own spray, and (b) it sits within its own trough and is difficult to accelerate. Where speeds below 15 miles per hour are necessary, the ACV is better operated as a boat.

(2) Over land, relative lack of control makes it dangerous to operate at much greater than 15 miles per hour except in open areas.

d. Control. The ACV has complete 360 degree freedom of motion like a helicopter. Direction is regulated by one or a combination of the following:

(1) Rudders

(2) Swivelling the propellers from side to side

(3) Directing the air cushion forces which suspend the vehicle from side to side. All of the control forces are aerodynamic, and make for a sluggish response.

e. Height. Absolute ground clearance is rarely more than a foot. However, a three-foot flexible curtain surrounds the base of the vehicle and contains the air cushion. This allows the vehicle to pass over objects from three to four feet in height.

2. The Mission

The current ACV procurement is experimental and no specific mission has been assigned. We shall focus upon a mission previously designated for ACVs for which information has been obtained.

Mission Identification

a. Amphibious cargo mission.

(1) The Army is assigned the supply mission while the Navy (Marine Corps) has the assault mission.

(2) The amphibious supply mission begins immediately after the assault and continues until a port facility is secured.

b. The Logistics Concept. This is an amphibious logistics concept developed to lower vulnerability to nuclear attack. Under this concept, the following would occur:

(1) Cargo vessels would be dispersed along the coast line as much as 75 miles off shore (below radar horizon).

(2) Shore depots would be widely dispersed up and down the coast line.

(3) Cargo would be deposited from one to five miles inland to avoid beach congestion.

B. THE REQUIREMENT

On the basis of the above mission and the information provided, prepare:

1. A mission analysis, i.e., identify the mission operations, mission parameters, and mission functions.

2. An environmental analysis, i.e., determine the potential environmental influences and their effects on equipment design, human performance requirements, training, etc.

3. Perform a systems component analysis, restricting your effort to <u>Over-Water Operation only</u>! <u>Note</u>: In doing so,

a. determine the required control navigational and surveillance tasks;
b. determine the performance standards;
c. specify training requirements;
d. specify equipment requirements;
e. specify personnel requirements.

4. Specify additional data required for a thorough analysis.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 18

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/JOB ANALYSIS

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: Smith, R. G., The Development of Training Objectives (Published)

ASSIGNMENTS: Read references, Chapter 3

OBJECTIVE: The student must be able to demonstrate (orally or in writing) a knowledge of the major steps and procedures used in preparing a task inventory, a knowledge of the five most commonly used methods of job analysis. The student must judge correctly at least 70% of a group of properly and improperly worded task statements on a practical exercise

1. Review of the six major steps in developing Job Performance Requirements (and then the Training Objectives).

   a. Systems Analysis--Within this, a mission analysis and a flow chart so that we can develop the "task inventory."
   b. Task Inventory--The duties within the job and the tasks making up each duty.
   c. Decisions about Performance Standards--What level of training?
   d. Detailed Task Description, breaking down each task into specific acts.
   e. Knowledge and Skill Components involved in the performance of the task.
   f. Each Specific Objective reviewed for:
      (1) Performance expected
      (2) Conditions of observation and measurement
      (3) Accuracy and speed standards

2. Sources of Information, now, for our Mission Analysis:

   a. Field Manuals and Doctrine.
   b. QMRs for weapons or support.
   c. Operational and Support documents.
   d. Visits to units--surveys.

e. Interviews with personnel.
f. Records and logs kept by the units.

3. Developing a Task Inventory: Define.

a. Job--made up of several duties.
b. Duty--major activities making up job.
c. Task--a group of activities occurring close together and composing a duty.

4. Preparing a Trial Task Inventory.

a. List all tasks and for each one include a clear statement of:
(1) What the soldier does
(2) What he does it to--if appropriate
(3) What he does it with--if appropriate
b. Keep the description of all tasks at about the same level of generality.
c. Then check it for completeness by using any one of several techniques of Job Analysis.

5. Basic Techniques of Job Analysis.

a. Questionnaire Survey--Soldier describes his job in general terms. Least expensive but most variable and unreliable.
b. Group Interview--Interviewer asks group of soldiers about their job duties. Least effective, but next to lowest in man-hour costs.
c. Observation Interview--Observe soldier at his job, as well as interview him. This yields adequate information, but is expensive since analyst must spend time watching soldier do his job.
d. Technical Conference--Group discussion of the job by experienced incumbents and supervisors. Very expensive.
e. The Individual Interview--The best, most efficient, most dependable, and of average cost. Questionnaire surveys and group interviews are bad!

6. Basis for Conducting the Individual Interview.

a. Obtain a job inventory by interviewing 10 to 20 soldiers actually performing jobs typical of those fully qualified in MOS typical units. Not the best qualified--specialize in more difficult tasks--or least qualified--specialize in easier tasks. (Trainees are sources of information about what is hard to learn, and old hands have the know-how and tricks-of-the-trade.)
b. Mail out the inventories to MOS types, and have them add any tasks they do that you failed to include. Some tasks detected that accounted for as much as 50% of soldier's time.
c. Interview job sample using inventory as a basis.

7. How Officers' Jobs Differ.

a. More difficult to analyze than EM jobs. Less standardized, more variable, more restricted to mental operations.
(1) Responsible for
(2) Insures

(3) Supervises

b. General framework for an officer inventory should include:

(1) Areas of responsibility

(2) Specific job goals and standards for each area

(3) To what extent his unit is achieving goals and standards in each area

(4) Identifying information-gathering activities in each area

(5) Identifying controlling activities in each area

(6) Relationships between physical activities (4 & 5) and job purposes (2 & 3)

8. Review Questions.

a. Define a duty.

b. Define a task.

c. Define a task inventory.

d. Describe the suggestions made for describing a task clearly.

e. List seven sources of information for developing task inventories.

f. List the major aspects of the framework for developing a task inventory for officers.

9. Practical Exercise. Complete Annex A.

Period No. 18, Annex A

PRACTICAL EXERCISE
ON
PREPARATION OF TASK STATEMENTS

NAME____

TITLE____

ADDRESS (Work)____

____

DIRECTIONS

1. Assume that judgments on frequency of performance, importance to mission, learning location, or others will be obtained from a large number of job incumbents on each of a series of given task statements.

2. You are to judge whether each statement as written appears to sufficiently identify a job task for the purpose of deriving initial judgments on the content of formal training courses. In other words, does the statement represent the <u>type</u> of statement appropriate for inclusion in a task inventory? Indicate your judgments by marking the appropriate blank with an "X" in "Part A."

3. You may qualify your judgments in "Part B" by marking one or more columns with an "X." There will be a few statements that you <u>should</u> qualify in Part B.

Statements	PART A: Does the statement appear appropriate for inclusion in a task inventory? Yes	No	PART B, Optional Qualifying Comments: The task statement is too general; probably includes several tasks.	The task statement is too specific; probably is a task element.
1. Maintains manning chart.				
2. Visit subordinate units.				
3. Perform aircraft maintenance.				
4. Verifies WOI and 2LT promotion eligibility.				
5. Recommend/approve/disapprove requests for overseas duty.				
6. Use table of organization and equipment (TOE).				
7. Checks 201 file to insure that recommended eliminations meet established criteria.				
8. Be qualified to repair the ARC-44 radio.				
9. Makes recommendation to the CG for approval or disapproval and character of discharge in elimination cases where respondent waives board action.				
10. Check completed board action to see if facts support conclusions.				
11. Torque nut to 360 foot pounds.				
12. Perform first and second echelon maintenance on tracked vehicles.				
13. Calibrate radio.				

	Statements	PART A Appropriate? Yes	No	PART B Optional Qualifying Comments Too general	Too specific
14.	Know the eleven general orders.				
15.	Take in shorthand minutes of board proceedings.				
16.	Know capabilities and limitations of the M-14 rifle.				
17.	Disassemble and assemble the M-16 machine gun.				
18.	Navigate aircraft by dead reckoning.				
19.	Compute curvature of track.				
20.	Schedule work.				
21.	Have a working knowledge of hand signals.				
22.	Write safety speeches for the Commander.				
23.	Apply protective and preservative materials to supplies.				
24.	Know methods of blocking and bracing materials on carriers to meet shipping requirements.				
25.	Plan, coordinate, and supervise sections engaged in map compiling and drafting.				
26.	Understand preparation of clay, plasticine and plaster mixtures for molding or modeling.				
27.	Determine azimuth by astronomical observation on the Sun or Polaris.				
28.	Select type of camera and accessories most suitable to assignment and photographic conditions.				

Statements	PART A Appropriate? Yes	 No	PART B Optional Qualifying Comments Too general	 Too specific
29. Indent paragraphs five spaces.	____	____	________	________
30. Clean and store laboratory equipment.	____	____	________	________
31. Approve addition and deletion of supply property.	____	____	________	________
32. Plot surface, upper air, and special meteorological reports.	____	____	________	________
33. Understand the importance of proper personnel assignment and utilization.	____	____	________	________
34. Inspect condition of ground power equipment and tools.	____	____	________	________
35. Sign correspondence.	____	____	________	________
36. Instruct students.	____	____	________	________

KEY TO: PRACTICAL EXERCISE ON PREPARATION OF TASK STATEMENTS

	PART A Appropriate?		PART B Optional Qualifying Comments	
	Yes	No	Too general	Too specific
1.	X			
2.		X	X	
3.		X	X	
4.	X			
5.	X			
6.		X		
7.	X			
8.		X		
9.	X			
10.	X			
11.		X		X
12.		X	X	
13.	X			
14.		X		
15.	X			
16.		X		
17.	X			
18.	X			
19.	X			
20.		X	X	
21.		X		
22.	X			
23.	X			
24.		X		
25.		X	X	
26.		X		
27.	X			
28.	X			
29.		X		X
30.	X			
31.	X			
32.	X			
33.		X		
34.	X			
35.		X		X
36.		X	X	

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 19

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/TASK ANALYSIS

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: Smith, R. G., The Development of Training Objectives (Published)

ASSIGNMENTS: Read references, Chapters 5 and 6

OBJECTIVE: The student must be able to define duties, tasks, and task elements; list a minimum of 15 types of tasks; prepare a format for a detailed task description; and discriminate between a fixed and a variable procedure as well as between discrete and continuous tasks. The student must be able to define knowledge and skill and to describe the process of organizing the knowledge and skill components of a given task

1. DUTIES, TASKS, AND TASK ELEMENTS

What is a duty?--a task? Tasks can be further divided into what we call task elements. A task element contains or describes:

a. A cue--or signal for S to perform an action.
b. An action--a precise description of:
   WHAT was done
   what it was done TO
   and what WITH.
c. An indication to S that his action was correct.
d. Remarks, precautions, etc.

2. DEGREE OF DETAIL OF WRITING

A completely untrained soldier could follow it.

3. DETAILED DESCRIPTIONS

Detailed descriptions will reveal gaps in the technical and training literature, steps left out, fuzzy unclear descriptions of procedures, etc.

4. SEVENTEEN TYPES OF TASKS

a. Operator Tasks

Fixed procedures - (Starting tank engine
(Putting radio set in operation

Variable procedures - (Tank gunnery search--but if target appears
(stop and fire--depending on type of target--
(the main gun or 30 cal.

b. Discrete versus Continuous Tasks

/ /

Maintenance Flying a plane

c. Tracking and Survey Tasks

/ /

Continuous Discrete

d. Searching and Scanning

e. Discrimination--S reacts in a different way to each of several cues--e.g., targets must be discriminated from cover and terrain. Identification is a special kind of discrimination.

f. Noise Filtering--Show on Radar--SONAR. Observe cues in presence of noise in training.

g. Short-term Remembering. Sentry--special instructions for his watch. Memory may serve either as an action or as a cue?

Action--cued by an instructor or another cue.

Cue--will recall some instruction previously given which will cause him to act.

h. Long-term Remembering--Memory aids, checklists.

i. Codes--In many jobs, codes and symbols are used. Morse Code, map symbols, phonetic alphabet. If task requires codes, describe the code as a knowledge item.

j. Decision Making and Problem Solving--To structure these complex tasks, some of the things to consider are:

(1) Cues directly presented--What creates the problem?
(2) Facts not directly presented--G2--Intelligence. Environment. Enemy.
(3) Available actions--What choices do I have?
(4) Action implications--Probability that Course A will work?
(5) Goal priorities--Heavy casualties, or let enemy take hill?
(6) Rules for selecting actions--(Decision rules are usually broad guidelines.)

k. Highly Skilled Actions.

Snipers, Rangers, LR Patrols, Demolitions--like Skiing
Photos, drawings, movies may be needed to show the skill level

l. Maintenance Tasks.

Preventive Maintenance
- Preventive actions
- Objects worked on
- Time that it's done
- Tools required
- Correct action

What information is in printed format
Precautions

m. Normal Operating and Checking Tasks.
n. Adjustment Tasks.
o. Trouble-shooting Tasks.
p. Repair or Replacement Tasks.
q. Clerical and Administrative Tasks.

5. PREPARING A FORMAT FOR DETAILED TASK DESCRIPTIONS

a. Identifying information:

MOS	Date
Duty	Name of Researcher
Task	
Subtask	

b. Time required for task or subtask.
c. Description of cues involved in task elements--surveillance cue and correct action.
d. Action to be taken.
e. Object of the action (control, equipment, form).
f. Indication of correct action if not covered in c. above.
g. Statements of precautions, common errors to avoid, and remarks and instructions.

6. TYPES OF TASKS

a. Discrete tasks--Step by step. Can be described in a columnar format.
b. Decision-making and problem-solving tasks:
   (1) Cues presented
   (2) Facts not presented
   (3) Available actions
   (4) Action implications
   (5) Goal priorities
   (6) Rules for selecting actions
c. Continuous tasks, use an outline format.
   (1) Display
      Problem--pattern of cues available
      Critical cue variables
      Time values
      Noise
   (2) Decisions
   (3) Actions
      Object acted on
      Specific action taken
      Effect of the action
   (4) Indication of correct action
      Indications or cues present after the action
      Time delay
      Criterion of correct action
      Critical values
      Corrective action to be taken if previous action was not correct
   (5) Characteristic errors and malfunctions

7. HOW TO PREPARE DETAILED TASK DESCRIPTION

a. Watch an experienced soldier. Stop and query.
b. Refer to and use manuals.
c. Have it checked by 3 to 5 experienced people following your description.
d. Try out on 3 to 5 inexperienced people to see if they can do the task.

8. DERIVING KNOWLEDGE AND SKILL COMPONENTS

a. What is knowledge? Set of mental processes allowing one to use symbols.
b. Guidelines for identifying knowledges in task descriptions.
c. To derive knowledge requirements, divide task descriptions into two groups: discrete and continuous, problem solving and decision making.
   (1) For discrete tasks: Name, identify condition and knowledge
   (2) For continuous tasks: Task cues, identify conditions, knowledge, task goal
d. To derive skill components, look for speed, accuracy, and coordination requirements; then list separately after reviewing task description.

9. REVIEW QUESTIONS

a. Define a task element.
b. Define and give an example of a cue.
c. Define and give an example of an indication of a correct action.
d. Diagram an example of a fixed procedure.
e. Diagram an example of a variable procedure.
f. Contrast a discrete and a continuous task.
g. Diagram an example of a discrimination.
h. Define knowledge
i. State the three elements which must be learned if knowledge is to assist effectively in task performance.
j. List 15 guidelines for identifying knowledge developed by Miller and Van Cott.
k. Define a skill.
l. Describe the process of organizing the knowledge and skill components of a task.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 20

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/JOB INTERVIEW

TYPE: Conference, demonstration

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: TV Tape: Job Interview

REFERENCES: None

ASSIGNMENTS: None

OBJECTIVE: The student must be able to describe, in a step-by-step fashion, the procedures and methods commonly used in the conduct of an observation-interview.

1. Presentation of job interview demonstration (TV tape).

2. Why did the interviewer "waste time" telling the job incumbent about the purpose of the interview? (Tell him he's not being tested.)

3. What is the difference between a job, a duty, a task, and a task element? (Job--a number of duties; Duty--one of several major activities comprising a job; Task--a group of activities close together with a common purpose; and a Task Element--the smallest unit of activity within a task.)

4. How many interviews are needed before you can be sure you have enough? (After initial revision, several more interviews uncover nothing else new; then shift to another type of unit and check the same MOS here. If nothing new, shift again. If still nothing new--QUIT.)

5. Should all your observation-interviews be carried out on job incumbents from the same type of unit in the same geographic location? (No. Make sure all types where MOS will serve are represented.)

6. If in the process of your interview you find the job holder discussing or describing some task or activity that is not on your list, what should you do? (Listen. Write it down and add it to list. If rare and unique, drop at the end in final lists.)

7. Why did the interviewer call the job holder back into the office after they had finished the field work? Why didn't he do everything in the office first? (For purposes or reliability and confirmation. Soldier himself needs reminding.)

8. How often should these sorts of job inventories or analyses be repeated? (Should be up-dated at least once a year.)

9. Would these sorts of interviews be more revealing if they were less highly structured or formalized? (No. Must be highly structured and organized if they are to be systematic and comprehensive.)

10. What were the steps followed in the job interview?

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 21

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/SELECTING TASKS TO TRAIN

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: Smith, R. G., The Development of Training Objectives (Published)

ASSIGNMENTS: Read references, Chapter 4

OBJECTIVE: The student must be able to list seven rationales for deciding what to train

DISCUSSION TOPIC OUTLINE

1. Rationales for Deciding Which Tasks to Train

a. Can they already perform the task?
b. How important is the task to mission success?
c. How soon after assignment must the soldier perform the task?
d. How many soldiers must perform the task?
e. How suitable is the job situation for learning the task?
f. How often is the task performed?
g. Is training the best way to get the desired action-- (i.e., job aids, check lists, or manuals might suffice)?

2. Integration of Rationales--Discussion Rules

a. Not taught.
b. Described or demonstrated.
c. Demonstration of correct performance.
d. Must demonstrate OJ accuracy and speed.
e. Must overlearn--additional practice.

3. The task inventory can be used to gain information about:

a. Frequency of task performance.

b. Importance of the task to mission success.
c. Ease of training on the job.

4. Planning a Job-Information Survey

a. Questionnaire format--Instructions, task inventory, questions.
b. The sample--Population, random sampling, size of the sample.
c. Administration plan.
d. Statistical analysis of results.

5. Review

a. List seven rationales for deciding what to train.
b. Describe in one sentence how a task inventory may be used to collect information concerning what to train.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 22

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/TRAINING OBJECTIVES

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: Smith, R. G., The Development of Training Objectives (Published)
USCONARC Pamphlet 350-14: Training-Student Performance Objectives (Published)

ASSIGNMENTS: Read Smith, Chapter 7;
Read USCONARC Pamphlet 350-14

OBJECTIVE: The student must be able to state orally or in writing the reasons why vague terms should be avoided in SPO statements, describe why behavior must be spelled out in action terms, list the five types of conditions under which behavior is to be observed, describe the two common types of standards used in SPO statements, and list at least three techniques that can be used to assist in achieving clarity of communication for the SPO statements

1. For each task you want to establish the TRAINING OBJECTIVE or OBJECTIVES. In order for you to communicate, the Objective should:

a. State the BEHAVIOR--terminal action--required.
b. The CONDITIONS under which the behavior is to be observed.
c. The STANDARDS the behavior must meet:
   Time limit
   Minimum number
   Percentage or proportion
   Acceptable deviation from the norm
   Lower limit

2. How do we go about STATING THE BEHAVIOR REQUIRED?

a. Let's look at a typical OBJECTIVE, as usually stated:
   "Understands the theory of radar."

b. How will you ever know and to what extent?
"Understands tactics"
"Believes in military justice"
"Knows baseball"
"Appreciates fine art"
"Accepts the need for discipline"

c. Should only be used when they are followed up by more explicit statements. We need a precise statement of what the student should be able to do when he completes the course or unit of instruction.

3. The CONDITIONS under which Subject's behavior will be observed. Name the five types that should generally be considered.

a. The Range of Problems the Subject must solve:
Map reading. All maps? How about aerial photos? Strip maps? Nautical?

b. Tools, Equipment, and Clothing Subject must use.
"Fly spacecraft to moon and back."
Bathing suit and overcoat

c. Special Job Aids and Manuals.
List in the OBJECTIVES all checklists and slide rules, TMs, etc., if needed in order to perform the task.

d. Environmental Conditions. If S has to perform in a place where the environment will affect the performance, the environmental conditions should be stated in the OBJECTIVES.

e. Special physical demands if the task has to be performed while dangling from the chandelier.

4. What are the STANDARDS the student must meet?

a. Generally, only two kinds of standards--ACCURACY and SPEED or TIME.
What percent of problems?
What percent of correct answers?
What tolerances or IMPACT on THE TRAINING SYSTEM?

b. What is the most important point of reference for the establishment of these standards? The system in which the student will work after the training is complete.

c. What will be the effect of certain kinds of errors on the job?
(1) Misjudging distance--overshooting runway--crashing.
(2) If can't get rid of grenade in 6 seconds, there may not be a second one.

5. Smith gives some examples of some well-stated COMPLETE OBJECTIVES, giving performance conditions and standards (p. 65).
a. Students must match the names of the bones of the body with locations.
b. Numbered on a drawing of a skeleton.
c. He must correctly identify 75% of the bones by name within 10 minutes.

6. THE PRINCIPAL REQUIREMENT is that the OUTLINE OF COURSE OBJECTIVES be CLEARLY UNDERSTOOD. How is this done? Three common ways:

a. Objectives can be reviewed by an expert in the subject matter.
b. A set of objectives can be used as a test, and also to check their clarity.
c. If objectives are clearly stated, another person can build a test that will measure

the performance desired by the writer of the objectives.

7. REVIEW

a. List five ambiguous terms which should be avoided in clear statements of objectives.

b. List and give an example of each of the five types of conditions which will be normally encountered.

c. List and give an example of each of the two kinds of standards.

d. Describe three ways in which the clarity of objectives can be checked.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 23

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/IDENTIFYING UNITS OF PERFORMANCE

TYPE: Practical exercise

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

OBJECTIVE: The student must be able to identify meaningful units of performance and statements of specific tasks, generalized skills and generalized behavior.

Period No. 23, Annex A

IDENTIFYING MEANINGFUL UNITS OF PERFORMANCE

Following are a number of statements of possible performance objectives. Using the notation scheme provided below, mark each statement as falling into <u>one</u> of the following categories:

MU	<u>More</u> than one Meaningful Unit of performance is involved.
MU-ST	Meaningful Unit of performance, Specific Task.
MU-GS	Meaningful Unit of performance, Generalized Skill.
MU-GB	Meaningful Unit of performance, Generalized Behavior.
MU	<u>Less</u> than a Meaningful Unit of performance is involved.
C	The statement is confusing, poorly worded, action involved is not clear, etc.

Upon completion of instruction the student must be able to:

1. Operate field radio communications equipment, to include the transmitting and receiving of messages in tactical radio communications nets. MU

2. Make road tests of wheel vehicles to determine malfunctioning components, parts, and accessories. MU

3. Lubricate wheel vehicles in accordance with lubrication charts and work orders. MU-GS

4. Transmit messages in International Morse Code using hand key at a minimum speed of 15 five-letter random code groups per minute. MU-ST

5. Identify authorized abbreviations used in military correspondence. MU-GS

6. Using conventional typewriter, type at minimum rate of 50 words per minute with no more than 3 errors for each 50-word passage. MU-ST

7. List the steps to be followed in erecting antennas. MU-LESS

8. Perform organizational maintenance on wheel vehicles, amphibious wheel vehicles, and associated accessories and equipment. MU-GS

9. List the nomenclature of automotive wheel vehicle components. C

10. Apply information contained in technical manuals, technical bulletins, lubrication work orders, and other publications and directives pertaining to organizational maintenance of wheel vehicles. C

11. Check and adjust the timing on automotive wheel vehicles. MU-GS

12. Explain the use of the Morning Report. MU-ST

13. Verify and reconcile personnel information with personnel records. C

14. Prepare and cook food, to include the weighing, blending, and mixing of food in accordance with prescribed Army procedures. MU-GS

15. Recall the phonetic alphabet. MU

16. Demonstrate appropriate military courtesy when interacting with superiors. MU-GB

17. Enter a station into a net. MU-ST

18. Type correspondence, orders, recurring and special reports, and similar material based on written instructions. MU-GS

19. Acquire a general knowledge of company administration procedures. C

20. Select the correct forms involved in processing extension of enlistment. MU-LESS

21. Process AWOL and desertion cases. MU

22. Maintain an awareness of the need for cleanliness when working in a mess hall. MU-GB

23. Supervise the installation of radio equipment. MU

24. Locate the TAB SET button on a conventional typewriter. MU-ST

25. Proofread typewritten material against source material. MU-GS

26. Indicate the record keeping procedures pertaining to disposal of unserviceable property. MU

27. Maintain leave records for unit personnel. MU-GS

28. Given a list of words, divide each word according to syllabication rules. MU-GS

29. Perform typing and related duties. MU

30. Bake a sponge cake, using a standard Army recipe. MU-ST

31. Conduct inspections of mess halls to determine cleanliness of wash tubs. MU-ST

32. Remove and adjust gap in spark plugs of a transportation bus. MU-ST

33. Ascertain that reports have been forwarded to the proper headquarters. MU

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 24

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/EVALUATION OF INSTRUCTIONAL OBJECTIVES

TYPE: Practical exercise

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: Baker. R. A., The Determination of Goals and Objectives (see Readings)

ASSIGNMENTS: Read references

OBJECTIVE: The student must be able to evaluate a proposed SPO according to the three-fold criterion of Behavior, Conditions and Standards

Period No. 24, Annex A

PRACTICAL EXERCISE
PREPARING INSTRUCTIONAL OBJECTIVES

There are three important characteristics of a statement of an instructional objective. They are:

A. States the behavior to be demonstrated by the student.
B. Identifies the conditions under which the performance must occur.
C. Indicates the standard of acceptable performance.

For each of the following statements, check whether each of these characteristics is present.

	A	B	C
1. Without the use of notes, the drill sergeant must be able to write a summary of the duties performed by the training manager of a training unit.	___	___	___
2. The sergeant must be able to prepare a Morning Report according to the regulation pertaining to units operating in the field.	___	___	___
3. The trainee must be able to take dictation using shorthand, the dictation being given at the rate of 120 words a minute.	___	___	___
4. A successful graduating class will be one in which over half the trainees earn a 2.0 grade point average.	___	___	___
5. The trainee must successfully complete all testing in a four month period to qualify for promotion.	___	___	___
6. The driver must be able to jack up a 3/4-ton truck in preparation for removal of a rear wheel. He may use the standard set of tools provided.	___	___	___
7. Only those applicants with an ACB score of 98 or higher will be accepted in Service Schools.	___	___	___
8. The trainee must know all first aid procedures.	___	___	___
9. The mechanic must be able to repair any electrical malfunction with the aid of proper tools and electrical schematics.	___	___	___
10. At the signal, "Watch your lane," all firers must be able to kill their target within five seconds.	___	___	___
11. The trainee must be able to use properly and adequately a protective mask in emergencies.	___	___	___

12. Given the necessary tools, part and shop facilities, the student must be able to completely overhaul a two-ton truck engine to manual specifications during the period of three eight-hour work days. ___ ___ ___

13. Given a book of recipes, the cook must be able to prepare the mix for approximately 50 lbs. of brownies. He must have the mix ready for baking within one-half hour. ___ ___ ___

14. Given a list of training objectives the conferee must be able to evaluate them. ___ ___ ___

15. The soldier must always adhere to the regulations set forth in the Uniform Code of Military Justice. ___ ___ ___

16. The trainee must be able to fire the M-14 Rifle at night with acceptable accuracy. ___ ___ ___

17. The trainee must be able to plot accurately course and speed changes using the proper chart graph and hand plotter. ___ ___ ___

18. On a target range at a distance of 150 meters the trainee must be able to hit within 8 centimeters of the center 7 times out of 10 rounds using the M-14 Rifle. ___ ___ ___

19. Under test conditions, crew members must demonstrate their ability to work as a team by readying the Hawkeye missile for firing within eighty seconds after a given signal. ___ ___ ___

20. All students must be able to satisfactorily pass the military driver's license test. ___ ___ ___

<u>Instructor's Key</u>

1. A, B	5. None	9. A	13. A, B, C	17. A
2. A, B	6. A	10. A, B, C	14. None	18. A, B, C
3. A, B	7. C	11. None	15. None	19. C
4. C	8. None	12. A, B, C	16. A	20. None

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 25

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/REVIEW

TYPE: Conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

1. Name two (2) critical limitations of Job Analysis. (ANSWER: Page 1 of Establishing Performance Requirements by Dr. McKnight)

2. Distinguish between "Systems Analysis" and "Mission Analysis." (ANSWER: Page 2 of Dr. McKnight)

3. What are some of the various sources of information that are used in a typical Mission Analysis? (ANSWER: Page 4 of Dr. McKnight)

4. What is a QMR? (ANSWER: Page 6 of Dr. McKnight)

5. What is the difference between a "discrete" and a "continuous" mission? (ANSWER: Page 9 of Dr. McKnight)

6. What is the relationship between component operation requirements and mission requirements? (ANSWER: Pages 9, 18 and 19 of Dr. McKnight)

7. What is meant by the term "function?" (ANSWER: Page 10 of Dr. McKnight)

8. What are some of the more important determiners of mission standards, i.e., speed, accuracy, and reliability of human performance? (ANSWER: Pages 12 - 15 of Dr. McKnight)

9. What environmental factors are most likely to influence human performance? (ANSWER: Pages 16 - 17 of Dr. McKnight)

10. What is meant by the term CDOG? (ANSWER: Page 20 of Dr. McKnight)

11. What types of tasks are best allocated to men and what types best to machines? (ANSWER: Pages 22 - 24 of Dr. McKnight)

12. What factors govern the use of job aids? (ANSWER: Pages 24 - 25 of Dr. McKnight)

13. What factors or variables need to be considered when the allocations of functions among the MOS are being considered? (ANSWER: Pages 28 - 29 of Dr. McKnight)

14. What are the six (6) major steps involved in developing the human performance requirements for a training program? (ANSWER: Page 7 in HumRRO RB 11 - The Development of Training Objectives--Dr. R. G. Smith)

15. Define and distinguish between each of the following: job, duty, task, task-element. (Page 14--Dr. Smith)

16. Compare the effectiveness of the five (5) techniques of job analysis, identifying the best and worst in terms of efficiency and cost. (ANSWER: Pages 16 - 17--Dr. Smith)

17. What are the differences, if any, in the task inventories of officer and EM jobs? (ANSWER: Pages 18 - 19--Dr. Smith)

18. What are the rationales for deciding what to include in a training program? (ANSWER: Pages 20 - 23--Dr. Smith)

19. What are the most important considerations underlying the use of the task inventory? (ANSWER: Page 24--Dr. Smith)

20. Distinguish between the terms population and sample. (ANSWER: Page 26--Dr. Smith)

21. Distinguish between a job (or task) analysis and a job (or task) description. (ANSWER: Pages 7, 16, and 31--Dr. Smith)

22. Distinguish between validity and reliability.

23. Name at least three (3) basic roles that Student Performance Objectives can play in a training program.

24. What are the three (3) essential elements making up the structure of a properly stated Student Performance Objective? Be able to identify good and poor objectives.

25. In manpower management, name four (4) principal uses made of standards.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 26

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING ANALYSIS/EVALUATION

TYPE: Examination

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

OBJECTIVE: To assess the student's knowledge of the principles and concepts of human performance requirements, job analysis procedures, performance standards and student performance objectives

Period No. 26, Annex A

EXAMINATION

(Answer any 11 of the 13 questions below)

1. List the six (6) major steps in developing the human performance requirements for a training program.

Ans. (1) Systems Analysis
(2) Task Inventory
(3) Decisions and Standards
(4) Task Description
(5) Knowledge and Skills
(6) Training Objectives

2. What are some of the various sources of information that are used in a typical mission analysis?

Ans. Official doctrine, System Design data, and Experience

3. Define and distinguish between each of the following: (1) job, (2) task-element, (3) duty, and (4) task.

Ans. (1) Job--Made up of one or more duties
(2) Task-element--Smallest motor movement or component part
(3) Duty--Several major activities making up a job
(4) Task--A group of activities occurring close together

4. Name and describe four (4) techniques of job analysis, commenting upon the expense and reliability of each technique.

Ans. (1) Individual Interview ------------ Most reliable and average cost
(2) Observation Interview ----------- Reliable, but quite expensive
(3) Group Interview----------------- Unreliable, but very inexpensive
(4) Questionnaire Survey ------------ Least reliable and least expensive
(5) Technical Conference----------- Highly effective but very expensive

5. What are some of the major considerations in the development of a task inventory for officers' jobs? How do they differ from inventories for enlisted men?

Ans. (1) More difficult to analyze because officers' jobs are less standardized, more variable, and more intellectual in nature. They do not permit clear statements of job tasks in performance terms.
(2) Inventories for officers' jobs usually list the major areas of responsibility and the job goals and standards for each area. Information-gathering activities. Actions taken to achieve the goals. etc.

6. Indicate the relationship between component operation requirements and mission requirements.

Ans. Once missions are identified, they must be analyzed into their component operations before the individual job requirements, knowledges, and skills can be identified. Thus the relationship is that of showing how job skills are related to job success.

7. Name and describe by giving examples of each, the three (3) necessary components of all properly stated student performance objectives if they are to succeed in communicating.

Ans. (1) Behavior)
(2) Conditions) - with appropriate examples
Standards)

8. List five (5) rationales for deciding what to include in a training program.

Ans. (1) How important to mission?
(2) How soon after assignment will job be performed?
(3) How many Ss perform the job?
(4) How suitable is On-Job Training?
(5) How often is the job or task performed?
(6) Is training the only way to reach goal?

9. Discriminate between the following pairs of terms:

(1) terminal and enabling objectives
(2) discrete and continuous tasks
(3) validity and reliability
(4) job analysis and job description
(5) system analysis and mission analysis

Ans. (1) <u>Terminal</u>--the goal of the instruction, i.e., the actual job or task
<u>Enabling</u>--helps to achieve or leads to the terminal objective, i.e., a step along the way
(2) <u>Discrete</u>--having a clear beginning or starting point and a clear stopping point or end
<u>Continuous</u>--one without a clear start and stop, i.e., having a continuous, smooth, uninterrupted movement
(3) <u>Validity</u>--measures what it is supposed to measure
<u>Reliability</u>--measures in a consistent manner
(4) <u>Job Analysis</u>--a procedural method for getting at job content
<u>Job Description</u>--a detailed step-by-step account of a particular job
(5) <u>System Analysis</u>--step-by-step breakdown or determination of all the parts and their interrelationships
<u>Mission Analysis</u>--one component of the System Analysis that spells out the goals of the organized activity

10. Give at least three (3) examples of each of the following units of behavior: (1) specific tasks, (2) generalized skills, and (3) generalized behaviors.

Ans. (1) <u>Specific Tasks</u>: Cleaning an M 1 Rifle
Making a salad
Repairing a tire puncture, etc.
(2) <u>Generalized Skills</u>: Repairing a gas-engine carburetor
Writing ATTs
Weighing chemicals on a chemical balance, etc.

(3) Generalized Behaviors: Maintaining troop morale
Promoting peace
Protecting the garrison, etc.

11. Name at least three (3) basic roles that student performance objectives can play in a training program.

Ans. (1) Furnish a basis for sound training decisions
(2) Standardize instruction
(3) Furnish the basis for the development of valid tests
(4) Promote better student-instructor relationships
(5) Focus the student on the goals of instruction and thus promote learning

12. Which of the following tasks are best allocated to the human being and which to a machine?

(1) Detecting signals in noise
(2) Selecting inputs
(3) Monitoring radiation levels
(4) Processing information via logical rules
(5) Functioning under overload
(6) Tracking rapid targets
(7) Use of flexible procedures
(8) Applying great force
(9) Generalizing from isolated particulars
(10) Completing repetitive tasks

Ans. (1) Human (6) Machine
(2) Human (7) Human
(3) Machine (8) Machine
(4) Machine (9) Human
(5) Human (10) Machine

13. Which of the following instructional objectives satisfy all three basic requirements for a well-stated SPO?

(1) At the signal, "Man Overboard," all radar operators aboard ship must be able to switch the DRT to short scale within 5 seconds. YES NO
(2) The student must be able to take dictation using Gregg shorthand, the dictation being given at the rate of 120 WPM. YES NO
(3) Given recipe book TM 79-210B, the student must be able to prepare a 60 lb. Brownie mix. YES NO
(4) While operating the on-board Mark V mobile radar set, the student must be able to report the bearing and range of a blip on the scope within 12 seconds to an accuracy of $\pm$ 2 per cent. YES NO

(5) The student must be able to train a six-months old white rat to bar press in a chain sequence to a degree of 70% accuracy. YES NO

Ans. (1) Yes (3) No (5) No
(2) No (4) Yes

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 27

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/LEARNING AND PERFORMANCE CONCEPTS

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: Haggard, D. F., Learning and Performance Concepts (see Readings)

ASSIGNMENTS: Study references, pp. 1 - 17

OBJECTIVE: Student must be able to relate learning to performance, describe the primary types of performance tasks, describe the S-R characteristics of performance tasks and relate S-R characteristics to learning concepts

1. PERFORMANCE: DEFINITION AND NOMENCLATURE

a. Starting point for training development is the terminal and enabling objectives plus quantitative standards of proficiency. Give examples and contrast performance and educational objectives.

b. Most military objectives are specific performance requirements rather than general educational goals.

c. Most straight forward approach to performance training is simple practice of objective activity until the trainee reaches the standard. However, for difficult or complex performances this procedure is slow and inefficient.

d. To increase efficiency of practice, trainer adds conditions that will enhance learning. With respect to the S-R definition of performance these conditions may modify the S or R characteristics or the trainee; S-O-R.

e. Examples of S-R characteristic modification:

(1) Content simplification and sequencing--reference validity, trainee level and value--Israel survey

(2) Presentation media--instructor, materials and aids as related to task

(3) Reception process--active vs. passive, feedback for conventional ammo with delay for missile firing

f. Examples of trainee (O) modification--motivation, distribution to overcome fatigue.

g. Many ways of modifying tasks for training (learning) purposes. Not all modifications are effective with all tasks. Different types of tasks respond differently to different modifications. For example (anxiety or stress or motivation):

(1) well trained gunner for demonstration, officer states importance of good results, gunner falls apart--here anxiety caused performance deterioration

(2) church inquisition and Korean brainwashing--here anxiety increases suggestibility, enhancing learning and later performance

h. Since tasks and methods interact we must consider the type of task before we can specify the most effective training method.

2. PERFORMANCE: RELATIONSHIPS TO LEARNING

a. Types of Tasks: Surveiliance (S Detection), Identification (S Selection), Procedures (chaining), Tracking (Perceptual-motor), Firing (simple response).

(1) Characterize by Stimulus, Response, Feedback

(2) Show differences in <u>Response</u> required

(3) Show differences in whether Stimulus characteristics can be <u>defined</u> or must remain undefined, e.g., target, kinesthetic cues

(4) Combine for S-R characteristic matrix

b. S-R by Training Methods--relate S-R matrix to methods in (4) above.

c. Interaction within matrix shows we must analyze task or use general methods in a shotgun approach which is much less efficient.

d. Basis for program planning which uses task and skill analysis to specify most efficient training approach will be presented under the administrative-media-technique paradigm.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 28

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/ADMINISTRATIVE REQUIREMENTS

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: Haggard, D. F., Learning and Performance Concepts (see Readings)

ASSIGNMENTS: Study references, pp. 17 - 22

OBJECTIVE: Students must be able to state the major learning-related administrative variables and the requirements they impose on the course manager

INSTRUCTOR OUTLINE

1. Problems for class (select one student to answer each problem immediately after all problems are read).

*a. You are an S-3 in the 2nd Brigade when the School Monitoring Division, DCSIT states that all schools are showing a 24% failure rate in Radio Code--Reply with reason.
*b. You are S-3 in 1st Brigade and find that 30% of AIT trainees are failing the Mil Relation class--Why?
*c. You are S-3 in Weapons Department when end-of-course exams for Turret Mechanics reveal very low scores in Electrical Theory--Justify.
d. Class members usually give two obvious reasons: (1) input does not meet GT (intelligence) requirements, (2) low motivation for various reasons.
e. Show I.Q. plus motivation not quite true; e.g., radio code more likely aptitude, mil relation more likely achievement such as past education in formulas and division, electronic theory most likely I.Q.
f. Shows need for trainee-course levels analysis: relevant trainee input requirements, initial course level, continuous monitoring of both.

2. Relevant Course Prerequisites

a. Most can be included under Intelligence, Aptitude, Achievement.
b. If cannot be met in assignment--change prerequisites to realistic levels and

reorient training. Do not be content to continue poorly designed training program by blaming failure on malassignments.

c. Continuously monitor levels of relevant trainee inputs for change that might require course redesign; e.g., require and get minimum GT of 100 but Project 100,000 suddenly drastically changes GT input.

3. Class Scheduling

a. State introductory level to match trainee input. Change level as input changes.

b. Where courses form a dependent series, state transition level from Course A to Course B as input prerequisite for B; not just the order of courses.

c. When course order is important, note for use by people scheduling courses for each class and monitor scheduling to ensure order is followed. Schedulers are usually more interested in facility availability and pretty flow charts for each class and will reorder courses on the slightest pretext.

d. Example: Mil Formula, initial level different for Officer and Enlisted classes because different initial levels of achievement; relatively long term change in Enlisted educational level would change initial course level (e.g., USATCA found few passing mil relation test, prerequisites based on older 10th grade education, present level was less so no idea of formulas and division basic to mil relation solution, started course at lower level and greatly decreased failures).

e. Second common reason for 1. above many times due to too high or too low initial course level--former loses student immediately while latter bores him.

4. Monitoring Output

a. Terminal objective important test but so also are enabling objectives to pinpoint potential or actual trouble spots. Trends of change can allow course correction before danger point is reached.

b. Any change in program can change final outcome. Results of modifications such as instructors new training aid or change in emphasis may be detected by end-of-course exams.

c. Baker's curves in outside reading:

(1) large number of variables affect curves

(2) variables do not effect different tasks equally

(3) even "experts" experimental course sometimes worse

d. Shows need for output monitoring to determine effects of changes and to guard against undertraining and overtraining in same program, as shown by Baker's curves.

e. Permanent records must be kept for monitoring purpose and must be based on objective test, not instructor's general questioning.

Period No. 28, Annex A

RANGE DETERMINATION TRAINING

Binocular

A. Adjustment of the Binocular
   1. Setting Interpupillary Distance
   2. Focusing (Diopter Setting)

B. Use of Binoculars
   1. Observing
   2. Use of the reticle
      a. Measuring horizontal angles
      b. Measuring vertical angles

The Mil Relation

A. Target Size
   1. Standard Size
   2. Interpolation of size

*B. The Mil

*C. The Mil Relation

1. $\frac{W}{R \times m\!\!\!/}$ becomes $W = R \times m\!\!\!/$

$$R = \frac{W}{m\!\!\!/}$$

$$m\!\!\!/ = \frac{W}{R}$$

where W = Width (or height) in meters
R = Range in thousands of meters
$m\!\!\!/$ = Angle in mils

*D. Determining Range

*E. Determining Mil Angle

*F. Determining Width

Range Determination Practice

1. Make proper binocular diopter and interpupillary settings.
2. Measure the mil width or height.
3. Determine target range by use of the mil relation.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 29

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/TRAINING TECHNIQUES

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: Cannon, L. D., The Mil Relation (Published)
Ware, J. R., A Pictorial Program for the M-73 Machine Gun (Published)

REFERENCES: Brown, G. H., Principles of Learning and Their Application to Training Program Development (see Readings)

ASSIGNMENTS: Read references

OBJECTIVE: Student must be able to describe the five principles for modifying tasks, state the requirements for their use, and provide two techniques for accomplishing each

INSTRUCTOR OUTLINE

1. Training techniques, principles, ad infinitum.

a. Start with objective as definition of task (S, R, Feedback), conditions, and proficiency standard. Most straightforward training would be to present task under conditions stated until standard is met. But this may be inefficient if we can increase rate or final level per period of time.

b. Usually task S, R, or feedback or modify trainee motivation. Will here consider S, R, feedback modifications.

c. Group major task modifications by simplification, student participation, meaningfulness, knowledge of results, and distribution of practice.

2. Simplification--when task characteristics are too complex or difficult for immediate apprehension.

a. S: target detection--initially highlight target characteristics in relation to background, stadiametric sights--stress reticle--target relations.

b. R: cross-country target tracking--consistent diagonal courses, starting engine--number controls in order.

c. feedback: centering reticle--cross on center of mass, target damage assessment--hit or miss.

d. Try to start at level of difficulty that is within trainee capability and increase in steps to final task characteristics.

3. Student Participation--Makes student respond to maintain attention, overt practice and provide for continuing instructor evaluation of presentation effectiveness.

a. Recitation and Review--end of course.

b. Within course questioning.

c. Programing--programed books on mil relation, M-72 machine gun, and 45 cal. pistol.

d. Programing--student response stations with automated instructor console.

e. Computers Assisted Instruction.

f. Warning against blind acceptance of technique and/or hardware. Fads in student participation. Effects of repeated interruption of presentation (linear text as good as scrambled text, slide queries and lecture flow). Need for trial-and-test method of development and adoption.

4. Meaningfulness--most important for low ability trainees who cannot visualize big picture or for tangential subject matter.

a. Intrinsic (natural) vs. Extrinsic (artificial)--artillery intrinsic for direct fire may require the addition of extrinsic during training in indirect fire, rifle firing increasing intrinsic effect of impact or adding extrinsic marker for point of impact.

b. Constraints--increase or addition must not become focal point of learning replacing task stimulus, complex tracking with buzzer pitch variation for approximation of on-target may lead to tracking buzzer only; Air Force gunnery device for azimuth, elevation and depth added red glow when at correct range and led to ranging by glow with no increase in depth ability.

a. Intrinsic (natural) vs. Extrinsic (artificial)--artillery intrinsic for direct fire may require the addition of extrinsic during training in indirect fire, rifle firing increasing intrinsic effect of impact or extrinsic marker for point of impact.

b. Constraints--increase or addition must not become focal point of learning replacing task stimulus, complex tracking with buzzer pitch variation for approximation of on-target may lead to tracking buzzer only; Air Force gunnery device for azimuth, elevation and depth added red glow when at correct range and led to ranging by glow with no increase in depth ability.

5. Distribution of Practice--to overcome fatigue or boredom.

a. Fatigue and Consolidation--length of rest interval.

b. Constraints--warm-up requirements, apparatus set-up time.

c. SS-10 Gunnery and XM35 simulator--studies showed direct relation of learning to distribution during hour (20 min. practice/10 min. rest $<$ 10/5 $<$ 5/2.5)--selected intermediate value.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 30

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/APPLICATION OF TRAINING PRINCIPLES

TYPE: Practical exercise

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

OBJECTIVE: Student must be able to apply the five task modification techniques to sample performance tasks

INSTRUCTOR OUTLINE

1. Practical Exercise Problem Tasks.

   a. Starting Engine in M48A1 Tank.
   b. Range Determination.
   c. Shillelagh Tracking.

2. Divide class into three study groups, each group to develop one task by analyzing S, R, feedback characteristics and stating techniques for increasing learning efficiency.

3. Group Leader presents results to class for class critique.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 31

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/TRANSFER OF TRAINING

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: Haverland, E. M., Transfer of Training (see Readings)

ASSIGNMENTS: Read references

OBJECTIVE: Student must be able to define the concept of transfer of training as it applies to program effectiveness

INSTRUCTOR OUTLINE

1. Definition of transfer--proficiency in A increases proficiency in B as shown by test. Examples for knowledge and skill.

2. Findings--

a. memory abilities--no transfer,
b. principles--high transfer if integrated,
c. motor skills--high transfer if compatible.

3. Kinds of transfer--

a. training to job--ex., Recon memory span low but grouping principles high.

b. within training segments--ex., theory related to job context, engine nomenclature and maintenance procedures over series of similar vehicles.

c. approaches to learning (learning to learn)--ex., low verbal ability trainees in lecture presentations, test-wise trainees effect achievement measures at end of training period.

d. transition training--transfer from old knowledge and skill results in higher trainee initial level, ex., tank ballistic computer series (Annex A).

4. Transfer conditions--

a. relevance to B--meaningfulness to next task; ex., over-all job sketch, prior knowledge of results of operations.

b. requirements for learning and performance--ex., positive and negative transfer of S and R on control manipulation task, Air Force gunnery trainer as example of negative transfer.

c. task element interaction--if high, practice on elements separately will show little transfer to total task.

d. time sharing--same as c.

5. Whole vs. part learning--

a. General relation to transfer conditions.

b. Relation to training device requirements--sequence of nomenclature, procedures, operation.

Period No. 31, Annex A
TRANSFER OF TRAINING EXAMPLES

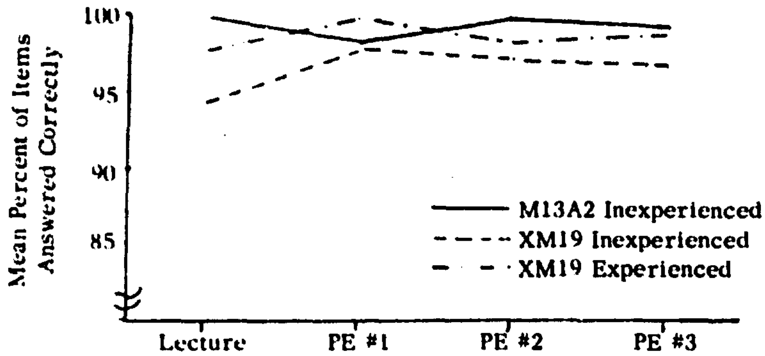


Figure 4--Phases of Instruction
Mean Performances of the Trainees on Nomenclature Category

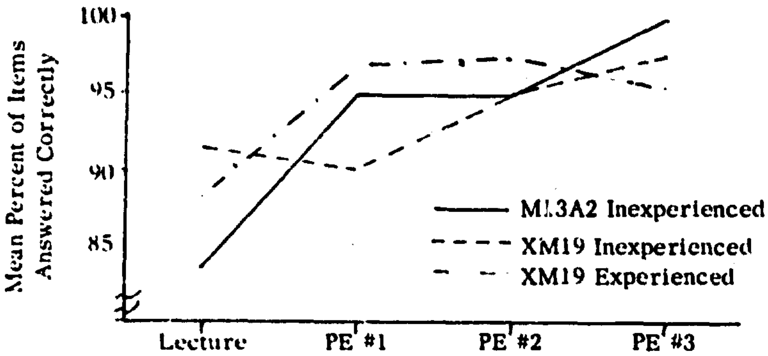


Figure 7--Phases of Instruction
Mean Performances of the Trainees on Dial Readings Category

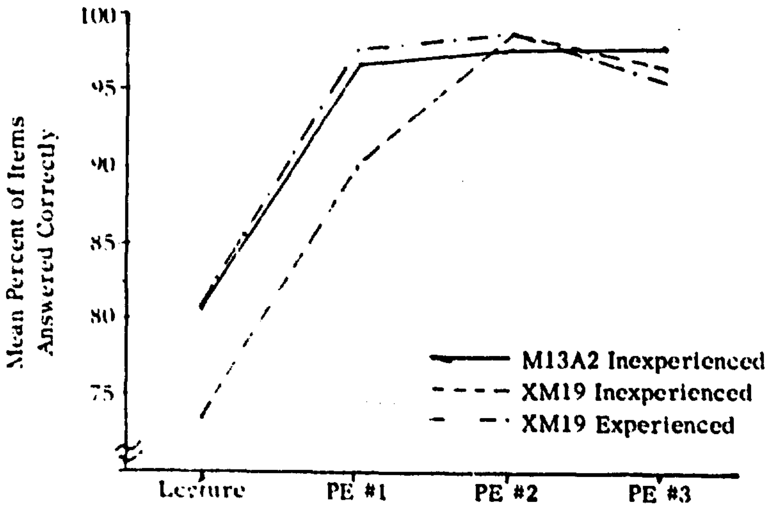


Figure 8--Phases of Instruction
Mean Performances of the Trainees on Operational Characteristics Category

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 32

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/MOTIVATION AND BEHAVIOR CONTROL

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: Ward, J. S., The Design of Motivation and Behavior Control Techniques (see Readings)
Cassileth, B., Practical Approaches to the Problem of Low Motivation in Army Trainees (see Readings)

ASSIGNMENTS: Read references

OBJECTIVE: Student must be able to define the three major components of motivation and apply each to a training requirement. Student must be able to define two behavior control techniques and demonstrate their application to military training

1. Motivational Cycle--Need, satisfying behavior, incentive.

a. Basic--physiological, safety, love, esteem hierarchy--esteem for training, not much for most trades and professions--including the Army (M. D. comparison).

b. Intrinsic--interest and success--high-level job content rewarding through accomplishment--not much for most Army jobs but good assignment policy helps.

c. Extrinsic--low-level job content not intrinsically rewarding--fringe benefits most important for Army, salary, working conditions (Hawthorne effect), opportunity for advancement (Radar Repair School policy of no promotion while in training).

2. Incentive Factors.

a. Emotional.
(1) Personal involvement and responsibility
(2) Active participation, responsibility for task outcome

b. Task.
(1) Knowledge of goals and difficulty level of task

(2) Tie to objective and job (AOB Maintenance courses not related to job), task difficulty (differentiate by ability, prior testing, programming comparison)

c. Intellectual.

(1) Success, curiosity, praise

(2) Success experience for small items to give low performers some incentive now (present rewards only for top scores), interest of instructor and obvious validity of test for job, praise and punishment (former best)

d. Social.

(1) Competition, group versus individual studies indicate individual best, but within group can have individual responsibility

(2) Rivalry between classes not as effective as individual with self

e. Reward.

(1) Kinds in Army (tangible and activity)

(2) Reliability and consistency (Radio Course, free time reward impaired by KP assignments to those having earned free time resulted in punishing some good performances)

(3) Significance--relative to individual so choice of several types should be offered

(4) Punishment--negative effects on motivation and learning, positive effect on inhibition of high probability undesirable response, therefore use to discourage undesirable behavior but not to encourage desirable behavior

(5) Schedule of rewards--continuous and partial comparison with later job activity let down when training schedule is discontinued of rewards

3. Behavior Control

a. Shaping--reward for low level performance and gradually increase requirement to job standard level.

b. Reinforcing activities--high probability behaviors as rewards (free time, golf, library, movie, etc.).

4. Job and Training--Interaction of schedules for each.

a. Partial reinforcement--most likely on job so should be final schedule in training.

b. Consistent behaviors--training may reward different behaviors than job so learning not relevant, ex., school stresses clean tools while Motor Sergeant ignores.

c. Consistent types of incentive--training stress on passes, etc. not consistent with job stress on punishment or promotion--good performance can be rewarded in same way for training and job.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 33

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/REVIEW OF TRAINING TECHNIQUES

TYPE: Conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

1. Task analysis for training.
2. Administrative management.
3. Task modification techniques.
4. Motivational techniques.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 34

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/MEDIA FOR SUBJECT MATTER PRESENTATION

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: Brown, G. H., Training Techniques (see Readings)

ASSIGNMENTS: Read references

OBJECTIVE: Student must be able to list the principle training media and stipulate major weaknesses of each

1. PROCEDURES TRAINING

a. Enabling Knowledges--nomenclature, location, functioning, procedure.
b. Skills--procedure speed and accuracy of response and perceptual discrimination.

2. INSTILLING KNOWLEDGE--ENABLING

a. Lecture--low aptitude problem, aids.
b. Discussion--requires knowledge of subject and verbal ability, again better for high aptitude.
c. Student response procedures.

3. PRACTICING PERCEPTUAL-MOTOR SKILLS--TERMINAL

a. Practical exercise--application of knowledge, immediacy of application of knowledge, integration with theory, could subsume 2. above.
b. Training devices--cover in detail later, note realism--cost-effectiveness relation to task requirement knowledge or skill.

4. PRACTICING MANAGEMENT SKILLS

a. Management procedures--case study, role-playing, gaming (oppose to maneuvers).
b. Evaluation of participation procedures.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 35

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/TRAINING LITERATURE

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Dr. Norman Willard

TRAINING AIDS: None

REFERENCES: Fink, C. D., Technical Manuals for Maintenance Support (Published)
Miller, E. E., Some Guidelines for Designing Technical Manuals for Use in Training (see Readings)

ASSIGNMENTS: Read references

OBJECTIVE: Student must describe uses of training literature, production procedures, necessary training characteristics and testing methods

1. TYPES AND PURPOSES OF LITERATURE

   a. Technical Manuals--repository of technical information.
   b. Field Manuals.
   c. Training Circulars, etc.--instructor aids.
   d. Training Manuals--student aids.

2. PRODUCTION OF MANUALS

   a. Manufacturer.
   b. Commodity Commands.
   c. Proponent CDC Agency.
   d. Proponent School.

3. MANUAL REVIEW PROCEDURES

4. DEFICIENCIES IN PRESENT MANUALS

   a. Purposes and uses.
   b. Timeliness.
   c. Comprehension.

d. Acceptance of new methods.

5. IMPROVING TRAINING LITERATURE

a. Include only information needed.
b. Increasing readibility.
c. Decreasing verbal requirements pictorially.

6. EVALUATION OF TRAINING LITERATURE

a. Troop testing materials.
b. Testing during development.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 36

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/TRAINING DEVICES

TYPE: Lecture, conference

TIME ALLOTTED: 4 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Parker, J. F., and Downs, J. E., Selection of Training Media (Published) (one per student)

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: Sample trainee response boxes, operable transparencies, animated panels

REFERENCES: Haggard, D. F., Training Devices (see Readings)

ASSIGNMENTS: Read references

OBJECTIVE: Student must be able to state the major types of training devices and describe the characteristics which determine their effectiveness and efficiency

1. TRAINING PROGRAM NEEDS

   a. Media and methods paradigm.
   b. Parker and Downs Cookbook--learning discussion on page 21.

2. THE TRAINING MANAGER'S FUNCTIONS

   a. Select the type of device needed.
   b. Specify device characteristics.
   c. Request development.
   d. Monitor development.
   e. Test device effectiveness.

3. DEVICE TYPES FOR DIFFERENT TRAINING STAGES

   a. Information.
   b. Demonstration.
   c. Practice.

4. DEVICES FOR INFORMATION PRESENTATION

a. Selecting device type.
   (1) audio-visual aids
   (2) trainee response devices
   (3) auto-instructional devices

b. Specifying characteristics.
   (1) represent trainee ability level
   (2) relate information to training requirement

5. DEVICES FOR DEMONSTRATION

a. Selecting device type.
   (1) cutaways
   (2) operable models
   (3) animated panels

b. Specifying characteristics.
   (1) input output relations that simplify concepts, eliminate irrelevant details, dramatize outputs or differences, provide a functional level of operation
   (2) generalizing information
   (3) relating otherwise disconnected areas

6. DEVICES FOR PRACTICE

a. Selecting device type.
   (1) number and interaction of task components
   (2) degree of environmental simulation
   (3) engineering vs. psychological simulation

b. Required physical realism.
   (1) engineering simulation from hardware and environmental variations
   (2) psychological limitation of engineering simulation from trainee capabilities and the anticipated level of training the device will be used in

7. REQUESTING DEVICE DEVELOPMENT

(to be covered during the next period)

8. TESTING DEVICE EFFECTIVENESS

a. Durability and reliability.

b. Training effectiveness.

c. Cost effectiveness.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 37

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/TRAINING DEVICE DEVELOPMENT

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: USAARMC, What's Your Training Aids Problem? (Published)
AR 705-5: Research and Development of Material (Published)

ASSIGNMENTS: Read USAARMC;
Study AR 705-5: pp. 5, 6, 7, 23, 24, 33, 36, 38

OBJECTIVE: Student must be able to describe the procedures for obtaining training devices and the information that is necessary to support device development efforts

1. TRAINING DEVICE SOURCES

   a. Local Training Aids Center--small items.
   b. Army Participation Group, NTDC--large items.

2. AR 70505 AND THE SMALL DEVELOPMENT REQUIREMENT

   a. p. 5--Responsibility of USCONARC.
   b. pp. 6, 7--Through CDC by QMR and SDR.
   c. pp. 33, 36--QMR format.
   d. pp. 23, 24--Additional requirements information.
   e. p. 38--SDR format.

3. INFORMATION NECESSARY TO THE SDR

   a. Program requirements.
      (1) Task description
      (2) Course description
      (3) Psychological parameters
      (4) Initial levels of trainee ability

(5) Degree of proficiency required

b. Support requirements.

(1) Instructor abilities

(2) Maintenance abilities

(3) Physical facilities

c. Utilization.

(1) Schools

(2) Units

4. DEFICIENCIES IN PRESENT SYSTEM

a. Lack of task, hardware and environmental information during hardware development.

b. Long lead times required for device development.

c. Lack of training manager continuity during device development.

d. Little communication between user and developer during development.

e. Army's ability to conduct training test.

f. Guidance on device utilization for users.

5. REVIEW OF SAMPLE SDR (Annex A)

a. No information on the vehicle characteristics when SDR was written.

b. Did have training facility information and past experience with similar vehicles.

c. Review information contained in SDR on the basis of 3 above.

Period No. 37, Annex A

DRAFT PROPOSED SMALL DEVELOPMENT REQUIREMENT (SDR) FOR A DRIVER TRAINER

2 PURPOSE AND OPERATIONAL CHARACTERISTICS

a. Purpose: This SDR is intended to develop a lightweight trainer wherein the driver may be initially oriented and trained to perform his duties. The trainer is not intended to give a driver complete driver training and eliminate the need for actual experience on the fighting vehicle. It is intended to give an initial feel for the driver's compartment and teach the proper use of controls, gauges, and warning lights prior to placing a trainee on the actual vehicle. The trainer will eliminate the necessity of immobilizing a fighting vehicle for basic driver training and provide a vehicle whereon, unlike an operational vehicle, observers can participate and view the driver's functions. This device will reduce cost of training by providing a vehicle which will permit a greater number of individuals to observe and be trained with less equipment.

b. Operational Characteristics: This device is required to provide training to drivers from initial familiarization with the driver's compartment to the actual operation of controls and components, and will be used primarily by the US Army Training Center, Armor. The trainer should be a relatively simple and inexpensive device requiring no sophisticated storage facilities or special training to use. The trainer need not incorporate costly Government Furnished Equipment (GFE) which is not necessary to accomplish driver training. In place of GFE items, identical mock-ups may be substituted. Removal and replacements of these mock-up items will conform to the operational equipment.

(1) (Essential) The trainer must duplicate dimensionally the driver compartment.

(2) (Essential) The trainer must be designed to permit close observation and direct verbal control of trainees by an instructor.

(3) (Essential) The trainer will be designed to permit greatest student participation by observation.

(4) (Essential) The trainer shall be as light and as compact as is consistent with performance requirements and mounted on casters to permit movement in the training area.

(5) (Essential) The trainer will be capable of operating from standard 110 volt or 220 volt AC current converted to 24 volt DC. The power converter will be part of the trainer.

(6) (Essential) The trainer will provide operational controls which will enable the trainee to:

(a) Practice proper starting and stopping procedures.

(b) Simulate driving under various conditions, such as up or down hill, on level ground, or through muddy terrain, requiring proper up shifting, down shifting and braking techniques.

(c) Take proper corrective action to correct malfunctions indicated by gauges and warning lights.

(7) (Essential) The trainer will have a master control panel by which the instructor can note the trainee's proficiency in accomplishing his actions. This panel will enable the instructor to insert malfunctions or specific driving situations as mentioned above into the driver's compartment, requiring corrective actions on the part of the trainee.

(8) (Essential) The trainer will provide for the installation and use of devices such as driver's periscope and night driving device.

(9) (Essential) The trainer will be capable of normal operation at temperatures ranging from 32° to 110° F.

(10) (Essential) The trainer will provide appropriate background noise to simulate vehicular engine running at different speeds to correspond to the driving situation.

(11) (Essential) Transportation Criteria: The trainer will be truck transportable and be capable of withstanding vibrations encountered in truck, ship, and rail transportation.

3. SUPPORT JUSTIFICATION AND DATA

h. Consideration of human factors including qualitative and quantative personnel requirements: No new skills or additional personnel will be required.

j. Consideration of probable maintenance effort and cost: It is envisioned that the trainer will require less care and maintenance than that provided the operational ______.

5. MAINTENANCE CONCEPT

Maintenance Concept: Maintenance required will be less than that performed on the operational vehicle and will be within the scope of an organizational mechanic.

6. BACKGROUND INFORMATION

b. The need for a driver trainer whereon drivers may be taught requires the development of a device which can be used more effectively than an operational tank. The use of an operational tank for preliminary instruction of drivers is not economical in that a limited number of persons may be trained at one time. The confined space of the operational driver's compartment limits the ability of the students to move and observe. Immobilization of the entire vehicle while the driver is receiving initial training removes a vehicle (which may be used for tactical, automotive, or gunnery training) from the inventory. Since training is conducted year round without regard to atmospheric conditions, driver trainers located in closed buildings offer a greater training value than does the use of operational vehicles parked in motor pools or adjacent open areas. The lightweight driver trainer requires no casting, is easy to construct and provides the greatest visibility to students and observers alike. Training agencies have often been criticized because replacements arriving at overseas and CONUS units are not qualified to operate equipment organic to the unit. This criticism resulted from past low priorities according to training agencies which did not receive new equipment until long after operational units were equipped. Suitable equipment must be provided training agencies in time to train transient operational crews and subsequent replacements.

c. If, during the development phase, it appears to the developing agency that characteristics listed herein require incorporation of certain impractical features and/or unnecessarily expensive components or devices, costly manufacturing methods or processes, critical materials, or restrictions which do not enhance the military value of the equipment, such matters will be brought to the immediate attention of the Chief of Research and Development and Commanding General, USACDC, for coordination and decision before incorporation into the final design.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 38

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/REVIEW OF THE M-34 DRIVER'S TRAINER

TYPE: Lecture, practical exercise

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: USATCA, AITA-A SUBJ SCD 17-131, Lesson Plan 20A: Driver's Compartment M60A1 Familiarization, 15 February 1967 (one per student)

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: One M-34 Driver's Trainer Instructor
One M-34 Driver's Trainer per four trainees

REFERENCES: Annex A to Period 37

ASSIGNMENTS: Read reference

OBJECTIVE: Illustrate, for the student, the utilization procedure for training devices

1. Introduction

a. Trainee prerequisites--1966 lesson plan required 14 hours of AIT-A driving and maintenance, present lesson plan requires no previous instruction.

b. Number of trainees--half company, averaging 45 - 50 trainees, usually results in 6 trainees per trainer with average of 20 minutes of training per man.

c. Assistant instructors--one per trainer, many for first time, receive 30 minute familiarization before they must conduct training.

d. Training requirements--

(1) familiarization with driver's compartment controls and instruments (21 items);

(2) starting and stopping procedures (13 steps);

(3) driving over various terrain conditions (sample of field conditions).

e Level of proficiency required--none stated and no end-of-class examination.

f. Trainer effectiveness evaluation--by "boarding" only.

g. Trainer maintenance--Training Aids Center.

2. Assistant Instructor Familiarization

a. Select M60 experienced students to act as assistant instructors (one per four students).

b. Instructor conducts normal familiarization training for assistant instructors, remainder of class observes.

3. Student Training

a. Assistant instructors conduct training prescribed by Lesson Plan 12A restricting time to 20 minutes per student-trainee.

4. Question and answer period between students and M-34 instructor.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 39

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/CRITIQUE OF DRIVER'S TRAINER SDR AND LESSON PLAN

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A to Period No. 37, Materials for Period No. 38

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

OBJECTIVE: Student must be able to review and critique training media development and utilization

1. Critique of Driver's Trainer SDR.

   a. para 2.a. Purpose:
      (1) define "initially oriented," "initial feel," and "proper use of."
         (a) Give initial level of knowledge and final level to be achieved for both knowledge and skill.
         (b) prerequisites: (initial)--trainer--(final)--vehicle.
         (c) Give for each requirement stated later, e.g., name, location, and use of components; start-stop procedure; driving over various terrains.
      (2) add "malfunction detection and corrective action" and "installation of special vision devices."
      (3) Give estimated maximum training time allowable.

   b. para 2.b. Operational Characteristics:
      (1) "initial familiarization"--see 2.a.(1) above.
      (2) "used primarily by"--What secondary users are anticipated and do their requirements and support capabilities differ from USATCA?
      (3) "simple and inexpensive"--meaningless terms partially defined by later operation and maintenance concepts.
      (4) "storage facilities"--define capabilities in terms of anticipated

vehicle characteristics and device concept.

(5) "special training"--define anticipated instructor abilities and training time allowable.

(6) "need not incorporate costly GFE"--Must use actual equipment only as necessary to training (workable mock-ups permissible when congruent with tasks being trained).

(7) "removal and replacement--conform." Not required by tasks listed for training.

c. para 2.b.1 dimensionality to extent indicated by task.

d. para 2.b.(3) State anticipated number of students per trainer.

e. para 2.b.(4) "as light and compact" "permit movement." Meaningless. Give anticipated maximum space allowable (number of trainers by floor space), maximum weight supportable by floors, and method of movement desired, e.g., four men with no special equipment. Add maximum readjustment allowable after movement.

f. para 2.b.(6)(b) "such as" --state sample of driving conditions needed. Who knows better than the Armor writer?

(c) corrective actions within compartment, what might they be?

g. para 2.b.(8) "use of" what uses? With no visual display this requirement is not clear. With visual display, state uses anticipated. Night driving not listed as condition of the task to be trained.

h. para 2.b.(10) Is a visual display also required to satisfy (6) and (8)?

i. para 2.b.(11) "truck transportable" What size?
"withstanding vibrations" Within what limits of readjustment?

2. SDR requirements for training device development are the same as requirements for development, or selection, of any training media.

3. Critique of Driver's Trainer Lesson Plan.

a. Instructor preparation time limited.

b. Student prerequisites appear to be based on scheduling requirements.

c. Training time suggests little learning, problem of presenting a lot in short period or only critical items.

d. Realism of terrain simulation and transfer to field, same for malfunction detection.

e. Evaluation of trainee lacking so have no idea of effectiveness of training.

f. Boarding rather than empirical test provided no basis for setting realistic trainee output requirements or training times. Also no idea of trainer effectiveness for meeting stated training requirements.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 40

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/NEW IDEAS AND EQUIPMENT FOR TRAINING

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: LTC W. B. Carter, DML, USAARMS
MAJ James V. Wasson, DML, USAARMS

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

OBJECTIVE: Student must know the present status of training development within USCONARC and the requirements for future training support

1. INTRODUCTION (5 minutes)

a. Purpose: To orient the student on the organization within the Armor School that follows the development of doctrine, materiel and literature; to discuss the procedures that were used in writing the SDR for training devices on the MBT-70; and to present the actual briefing that was given to the Vice Chief of Staff on a recommended approach to developing training devices for combat vehicles.

b. Reason: Following the development of new ideas and equipment is an essential part of training management.

c. Procedure:

(1) First hour will be devoted to the organization of the office of Doctrine, Materiel and Literature and the procedures this office used in developing the SDR for training devices on the MBT-70.

(2) Second hour--devoted to the briefing for the VCofS.

(3) There will be ample opportunity for questions. We are making the assumption that the students are familiar with the terms used in development of equipment.

2. EXPLANATION (85 minutes)

a. Organization and functions of the Office of DML.

(1) Threefold mission of USAARMS.
(2) Organization that performs these functions.
   (a) Explain USAARMS organization.
   (b) Explain Office of DML organization.
   (c) Explain functions of each Division.
(3) Essential concepts in operation of office.
   (a) Instructors are the experts.
   (b) Office is focal point--Doctrine is everyone's business.
(4) Background of individuals in the office.
   (a) VN returnees.
   (b) Graduates of Advanced Class.
   (c) Troop experience.
   (d) Varied backgrounds, i.e., Engineers, Systems Analysis personnel.
   (e) Ability to write.
   (f) TS security clearance.

b. Explanation of procedures used to develop SDRs for MBT-70 training devices.

c. Briefing on training devices associated with combat vehicles.

3. SUMMARY (10 minutes)

a. Clear up questions.

b. Review high points.

c. Closing Statement. The Armor School is vitally interested in the development of new ideas and equipment for this is where many of the training problems exist. Whether or not you become directly involved in this operation is immaterial. At least you now have an insight as to what the Armor School is doing to support the introduction of new ideas and equipment.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 41

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/REVIEW OF TRAINING METHODS DEVELOPMENT

TYPE: Conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex B to Period No. 10 (one per student)

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

1. REVIEW

a. Student Performance Objectives and the Training Program Paradigm.
b. Program Par. ligm.
(1) Administrative--student input abilities, monitoring through tests, time periods, sequencing.
(2) Training Media--lecture, film, TV, gaming, role-playing, devices, equipment.
(3) Training Techniques--motivation, knowledge of results, student participation, distribution of practice, meaningfulness of material, functional context.
(4) Psychological Principles--task presented as S-R-Feedback with different S-R principles; trainee as abilities and personality characteristics such as anxiety related to motivation; transfer of training with particular reference to simulation devices.

2. PROGRAM DEVELOPMENT AND CRITIQUE

a. Used device development as a model for any kind of curriculum development.
b. Annex A paralleling R&D cycle for information input.
c. Past method--M34 Drivers Trainer, based on past experience with similar systems for training method and characteristics.
d. Present method--Major Wassen, based on past experience plus job task descriptions.
e. Future method--LTC Carter, full-scale program as Annex A.
f. Repeat--Training program development follows same pattern; Past--old lesson plans rewritten; Present--same. h so e changes due to knowledge of job; Future--full development.

3. TESTING METHOD EFFECTIVEN_

a. Training Effectiveness--does it train and can it be supported?

b. Cost Effectiveness--Proficiency levels obtained versus cost as compared to other methods.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 42

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/TRAINING PROGRAM DEVELOPMENT

TYPE: Conference, practical exercise

TIME ALLOTTED: 8 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student), A SUBJ SCD 21-5: Guard Duty, June 1964 (Published) (one per student), FM 26-5: Interior Guard, August 1956 (Published) (one per student), sample Lesson Plans for Guard Duty Instruction

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: USCONARC REG 310-6: Preparation of Army Subject Schedules (Published)

ASSIGNMENTS: Read reference, pp. 7 - 11, Appendix IV

OBJECTIVE: Students must be able to review and critique proposed Subject Schedules, supporting literature and lesson plans

1. Review requirements imposed by change in objective.

2. Army Subject Schedule requirement.

   a. Discuss Requirement 1 of Annex A.
   b. Student response (60 minutes).
   c. Review of student response.
      (1) security mission orientation
      (2) contrast and compare to interior guard
      (3) increase practical exercise with security situations

3. FM 26-5: Interior Guard requirement.

   a. Discuss Requirement 2 of Annex A.
   b. Student response (60 minutes).
   c. Review of student response.
      (1) inappropriate sections--new general orders, decrease pomp (put in appendix

or FM 22-5: Drills and Ceremonies)
(2) appropriate sections (security oriented)
(3) add exterior guard and contrast with interior guard
(4) readability of text
(5) sections providing teaching gui ˎ s, training aids and testing methods could be added

4. Lesson Plan-Lecture requirement.

a. Discuss Requirement 3 of Annex A.
b. Student response (60 minutes).
c. Review of student response.
(1) standards and trainee readiness
(2) training methods
(a) low trainee ability techniques
(b) contrasting techniques
(3) trainee examination-objective method, content mirrors standards, recorded scores

5. Lesson Plan-Practical Exercise requirement.

a. Discuss Requirement 3 of Annex A.
b. Student response (60 minutes).
c. Review of student response.
(1) same as 4c above
(2) additional training methods
(a) security exercise stations
(b) continuous, immediate instructor critique at each station

Period No. 42, Annex A

TRAINING MANAGEMENT PRACTICAL EXERCISE
TRAINING PROGRAM DEVELOPMENT

TRAINING OBJECTIVE: The objective of guard duty training is to teach the basic soldier his specific duties as a sentinel on interior guard duty at a post, camp, or station

LITERATURE: FM 26-5 Interior Guard

A SUBJ SCD 21-5: Guard Duty, 4. Basic Combat Training (4 hours)

SITUATION: You are responsible for the review of A Subj Scd 21-5 June 1964 Guard Duty to bring it in line with a newly stated Training Objective, which is:

> The objective of guard duty training is to teach the basic soldier the fundamentals of security. Emphasis will be placed on field security with security in camp, post or station conforming to field security as much as possible.

REQUIREMENT:

1. Rewrite A Subj Scd 21-5, Section III Lesson Outline, 5. Basic Combat Training (4 hr.) to meet the above newly-stated training objective. Retain the 4 hr. time period but re-orient the content and instructional methods.

2. Review and critique FM 26-5 for applicability to the new course of training. State sections considered to be inappropriate, why they are inappropriate, and how they should be reoriented. State sections, if any, which may be appropriate to the new training objectives and the reasons why they seem appropriate.

3. Outline the Lesson Plans for one hour of Lecture-Conference-Demonstration and one hour of Practical Exercise based on your reoriented course in 1. above. For each hour present Standards; a brief summary of content and methods, including classroom procedures and training aids utilized; and the method and content of an end-of-period trainee examination.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 43

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING PROGRAM/EXAMINATION OF PRINCIPAL CONCEPTS

TYPE: Examination, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Donald Haggard

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

NAME ______________________________

1. If we were to measure and graph performance at the end of each sub-unit of training for a particular task we would obtain an S-shaped curve. T F

2. Studies have shown that discussion is superior to lecture for most training courses. T F

3. Low ability trainees can be motivated by setting a required achievement level that they can easily accomplish. T F

4. Group competition is more effective than individual competition. T F

5. The underlying process in training is:
   a. performance
   b. education
   c. learning
   d. motivation
   e. teaching

6. The range of skill that results from a training device program reflects the range of ______________ and ______________ variation included in the trainer.

7. List three administrative considerations that are vital to the success of any training program:
   a. ______________________________
   b. ______________________________
   c. ______________________________

8. List two objectives of most management or leadership practical exercise procedures:
   a. ______________________________
   b. ______________________________

9. Specific skills can best be developed through the use of practical exercise. T F

10. List the three aspects of training device effectiveness that should always be tested:
   a. ______________________________
   b. ______________________________
   c. ______________________________

11. The effectiveness of a training publication can only be determined by testing it with the prospective user. T F

12. Give an example of a reinforcement technique that would "shape" a response until a desired behavior is achieved.

13. Standards are necessary for each homogeneous part of a training course. T F

14. The range of variation that must be provided by a training device can be simplified on the basis of ______________________ and ______________________.

15. Baker's study of Armor skill training showed that a good training manager can always up-grade training by simply applying new knowledge as it becomes available. T F

16. One use of demonstration type training devices is to ______________________

17. Learning results in a change in behavior that is brought about through ____________.

18. The usability of a publication depends as much on such factors as size, indexing and quality of illustrations as it does on readability. T F

19. Practice in memorizing an assortment of materials will result in an improved ability to memorize. T F

20. Technical Manuals are published to be used in support of training. T F

21. Relating all subject matter in a course to the ultimate job situation is termed the ______________________ technique.

22. Knowledge of Results pertains to the observable part of performance we term ______________________.

23. Contingency management of reinforcement utilizes:

a. a change in stimulation.
b. a high probability behavior.
c. a need satisfier.
d. a drive reducer.

24. The selection of variables to be included in a training device should be based on physical realism alone. T F

25. The stimuli presented in training manuals can be given more meaningfulness for low ability trainees if they are presented in ______________________ torm.

26. List two practical exercise procedures for bridging the gap between the general facts and principles of management and their application to real-life problems.

a. ______________________
b. ______________________

27. If we integrate nomenclature training with training on function we are employing the technique of ______________________________.

28. The more frequent and longer the rest periods are during training, the more efficient training will be. T F

29. The three performance events that can be observed and measured are:

a. ______________________
b. ______________________
c. ______________________

30. ______________________________ occurs if the learning of one thing results in either easier or more difficult learning of a second thing.

31. The need for a training device is specified by the unavailability of actual equipment. T. F

32. Most transition training requires special attention to possible negative transfer effects. T F

33. Name an Army task which provides natural knowledge of results, state a change in the task that would require the addition of artificial knowledge of results, then state one technique of providing artificial K of R.

a. Task ____
b. Change ____
c. Technique ____

34. Training techniques have a greater effect on low ability trainees than on high ability trainees. T F

35. State one way of obtaining the active participation of all trainees during the presentation of knowledge by either lecture or training manual.

____

36. The change in behavior brought about through learning is relatively transient. T F

37. Transfer of training is the primary purpose of all training programs. T F

38. List the three management activities which require a knowledge of trainee readiness.

a. ____
b. ____
c. ____

39. Distributing practice is most important for skills which are fatiguing to perform. T F

40. List and define two types of partial reinforcement:

a. ______________________________

b. ______________________________

41. Most administrative considerations are not only over emphasized but actually have no place in the planning of effective training programs. T F

42. Learning can be observed directly through the measurement of trainee performance. T F

43. List three human needs that can be used as a basis for motivation in Army training:

a. ______________________________

b. ______________________________

c. ______________________________

44. Probably the least considered aspect of training progam development is:

a. administrative methods
b. training media
c. training techniques
d. training evaluation

45. Late in training, the performance curve may begin to level off due to the:

a. physiological limits of the trainee
b. trainee becoming tired
c. engineering limitations of the equipment
d. trainees capacity for processing information
e. all of the above

46. List the three major determiners of trainee readiness and for each determiner state one task i which it is probably most important:

a. ______________ ______________

b. ______________ ______________

c. ______________ ______________

47. The basic factor in transfer of training is the ______________ betw en training and the job.

Period No. 43, Annex A

KEY TO EXAMINATION ANSWERS

1. F
2. F
3. T
4. F
5. c.
6. equipment and environmental
7. a. trainee readiness
   b. trainee evaluation
   c. class sequencing
8. a. emotional insight, new prespectives
   b. experience in decision making
9. T
10. a. reliability and durability
    b. training effect
    c. cost effect
11. T
12. increasing sequence of standards
    reinforcement of partial response
13. T
14. human capability and training level
15. F
16. aid understanding, show procedures, simplify, etc., overview
17. practice
18. T
19. F
20. F
21. meaningful functional context
22. feedback
23. b.
24. F
25. pictorial, active, realistic
26. a. case study, gaming
    b. role-playing, in-basket technique
27. meaningfulness (functional context)
28. F
29. a. stimulus
    b. response
    c. feedback
30. Transfer of training
31. F
32. T
33.

a. Task	gunnery tracking	Trainfire	conventional firing
b. Change	missile round (delayed hit feedback)	night quick-kill (not hit information)	panel target (reduced hit feedback)
c. Technique	write-out return	flash signifying hit	falling target or pyrotechnics

34. T

35. self-tutor text, response boxes, periodic short quizzes, random recitation
36. F
37. T
38. a. course prerequisite and input levels
    b. scheduling of class periods (sequencing)
    c. input assumptions for initial level of material
39. T
40. a. fixed interval--first R after period
    variable interval--first R after random periods
    b. fixed ratio--every nth R 10:1
    variable ratio--every nth R average 4/6/10/14/16:1 = 10:1 average
41. F
42. F
43. a. Basic
    b. Intrinsic specific
    c. Extrinsic
44 c.
45. e.
46. a. I.Q. electronic theory
    b. ability morse code reception
    c. achievement mil formula range determination
47. degree of similarity, relationship, fidelity

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 44

LESSON OUTLINE

INSTRUCTIONAL UNIT: QUALITY CONTROL/SYSTEM VIEW OF TRAINING AND QUALITY CONTROL

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: Mr. William Osborn

TRAINING AIDS: None

REFERENCES: Cogan, E. A., System View of Training and Quality Control (see Readings)

ASSIGNMENTS: Study reference

OBJECTIVE: Student must be able to a) list three objectives in evaluating training efficiency, and b) correctly sequence elements of a quality control system (enabling)

1. REVIEW OF SCHEDULE

2. GENERAL CONCEPT OF "PERFORMANCE CRITERION"

   a. Standard of performance for man as with machine in meeting system mission.
   b. Must have check on man as "Production Item."

3. THREE LEVELS OF PERFORMANCE EVALUATION

   a. Total on job performance evaluation.
      (1) E.G., Enlisted Evaluation Center Proficiency Tests
      (2) Criterion for various personnel actions: promotion, pay increases, etc.
   b. End of training performance evaluation.
      (1) Evaluate job relevant behaviors given in terminal training objectives
      (2) Criterion for job entry
   c. In-training performance evaluation.
      (1) Evaluate enabling performances
      (2) Criteria for advancement through stages of training

4. ELEMENTS OF A TRAINING QUALITY CONTROL SYSTEM

OBJECTIVES OF QUALITY CONTROL:	HOW THESE OBJECTIVES ARE MET: PRESENTLY	IDEALLY
Quality Assurance	. Use administrative criteria primarily . Some proficiency criteria	Use only proficiency criteria derived from field needs
Control of Trainee's Progress	. Remedial action is either to recycle or cram and quality . Accelerated progress not normally allowed	Trainee is continuously evaluated, selectively corrected, and advanced as standards are met
Program Improvement	Programs normally changed by administrative edict: e.g.s, ----more training time to meet changes in equipment or doctrine OR ----"All schools will 'program' their instruction"	Weaknesses in program identified by substandard performance of trainees

HumRRO DIVISION NO. 2 (ARMCR)

TRAINING MANAGEMENT
Period No. 45

LESSON OUTLINE

INSTRUCTIONAL UNIT: QUALITY CONTROL/INFORMATION FOR QUALITY CONTROL

TYPE: Lecture, conference

TIME ALLOTTED: 1 hour

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)
Annex B (one per student)

PERSONNEL: Mr. William Osborn

TRAINING AIDS: None

REFERENCES: Cogan, E. A., Information for Quality Control (see Readings)

ASSIGNMENTS: Study reference

OBJECTIVE: Student must be able to list the three kinds of quality control information and illustrate how they pertain to the objectives of quality control (Enabling)

1. Information Used in Quality Control

		INFORMATION FOR QUALITY CONTROL	
		TERMINAL ↓ PROFICIENCY TESTING	ENABLING ↓ ACHIEVEMENT TESTING
Objectives of Quality Control	Control of individual trainee's progress		X
	Quality assurance	X	
	Program improvement	X	X

2. End-Course Proficiency Test Provides Both:

   a. Pass - Fail data on terminal performances.

3. Annex A

a. Pass -Fail scoring for student qualification.

b. Check-list on enabling skills and knowledges (procedures, TMs, test equipment) for program improvement.

4. Annex B--Quiz.

Period No. 45, Annex A

SAMPLE PROFICIENCY TEST ITEM

NAME______________________________ UNIT______________________________

63C DATE______________________________

TEST ITEM 6

MALFUNCTION: Open starter control circuit. #74 wire--M-35A1

SYMPTOM: No starter action

SPECIAL TOOLS AND EQUIPMENT: LVCT, multimeter, test lamp

DIRECTIONS TO THE TESTER

Tell the subject: "Starter will not operate when starter switch is pressed. Find the trouble and report it to me."

(Check subject's performance only as each step is completed.)

Steps 3, 4, 5 need not be in sequence.

SUBJECT'S PERFORMANCE		YES	NO
1. Turn accessory switch on and depress starter switch. Observe panel lights and gauges.	(F)	____	____
2. Connect voltmeter across batteries, depress starter to check battery condition.	(O)	____	____
3. Check for voltage to magnetic starter switch #14 wire with accessory switch ON starter depressed.	(O)	____	____
4. Check for voltage to starter switch #74 wire.	(E)	____	____
5. Check for voltage from accessory switch #74 wire.	(F)	____	____
6. All parts correctly re-installed.		____	____

7. Parts erroneously condemned. (Write in.)

SUMMARY PERFORMANCE CHECKLIST

SUBJECT____________________ TESTER________________ ITEM NO.________

I. SUBJECT DETECTED MALFUNCTION OR COMPLETED OPERATION PROPERLY . . . . ____

CHECK ONE
- 0. Used good procedures; knew what he was doing. ____
- 1. Had a pretty good idea, but some guesswork. ____
- 2. Knew very little; probably just a good guess. ____
- 3. Knew very little; but used publication accurately. ____

II. SUBJECT FAILED. . . . . ____

CHECK ONE
- 0. Didn't know enough to get started. ____
- 1. Started but gave up very quickly. ____
- 2. Some knowledge of what to do but much guesswork also. ____
- 3. Had fairly good grasp of the problem but failed. ____

CHECK ANY STATEMENTS BELOW THAT APPLY TO OR EXPLAIN FAILURE OR POOR PERFORMANCE OF SUBJECT

<u>Procedures</u>

- 00. Proceeding O.K. but too slow. ____
- 01. Didn't know essential operation or step no. (____). ____
- 02. Didn't make essential "operational" checks such as revving up engine, turning switches, etc. ____
- 03. Incorrectly reinstalled parts. ____

<u>Location of Malfunction</u>

- 04. Unable to pick out correct system to work on. ____
- 05. Got right system but wrong components. ____
- 06. Got right system and right components but couldn't test them. ____

<u>Use of Special Tools and Test Equipment</u>

- 07. Failed to use special equipment. ____
- 08. Tried to use it but didn't know <u>how</u> to hook it up. ____
- 09. Tried to use it but didn't know <u>where</u> to hook it up. ____
- 10. Knew <u>how</u> and <u>where</u> but didn't know procedures. ____
- 11. Used it properly but couldn't read results of checks. ____
- 12. Used wrong equipment for test or check. ____
- 13. Put too much ( ) or too little ( ) stress or load on equipment. (Check one.) ____

<u>Use of Publications</u>

- 14. Didn't use publications. ____
- 15. Selected wrong publication. ____
- 16. Selected right publication but couldn't find right section. ____
- 17. Selected right publication and section but
  didn't understand instructions. ____
- 18. didn't understand wiring circuit diagram. ____
- 19. didn't understand troubleshooting diagram. ____
- 20. didn't understand technical specifications. ____

Period No. 45, Annex B

QUIZ

1. Below are listed the elements of a quality control system. These have a particular sequence which designates the operation of quality control. Place these elements in sequence by assigning a number to each; the number 1 for the first in the sequence, 2 for the second, and so forth.

_____ procedures for improving training
_____ data reduction and analysis
_____ training objectives
_____ communication procedures
_____ managerial support
_____ measuring instruments

2. List the three goals of a quality control system; then place a check after each goal to show which type of training-objective (terminal or enabling) is used as the starting point in meeting each objective.

	Terminal	Enabling
a. ______________________	_____	_____
b. ______________________	_____	_____
c. ______________________	_____	_____

KEY TO QUIZ

1. 5, 3, 1, 4, 6, 2

2.

	Terminal	Enabling
a. Quality Assurance	X	
b. Student Progress		X
c. Program Improvement	X	X

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 46

LESSON OUTLINE

INSTRUCTIONAL UNIT: QUALITY CONTROL/ASPECTS OF TEST ITEM CONSTRUCTION

TYPE: Lecture. conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Mr. William Osborn

TRAINING AIDS: None

REFERENCES: Osborn, W. C., Characteristics of Tests (see Readings)

ASSIGNMENTS: Study references

OBJECTIVE: Given a series of detailed descriptions of test procedures for evaluating performance on stated training objectives, and where a test procedure may be deficient in one or more of three respects--relevance, standardization, and objectivity of scoring--student must identify the deficiencies in 80% of the cases

1. STANDARDIZATION OF CONDITIONS

   a. If it's a test, no excuse for <u>not</u> standardizing.
   b. Instructions.
      (1) Should be read
      (2) Complete to minimize questions
      (3) If questions, answer to all examinees
   c. Tester attitude: Brown Board example where rank of testers interacted with rank of examinees.
   d. Test supplies and equipment.
      (1) All use same equipment, and equipment restored to pretest condition; or
      (2) Each use different equipment, same calibration
   e. Environmental conditions.
      (1) E.g.,s: Time of day, visibility, terperature, etc.
      (2) Variations between versus within testing sessions

2. OBJECTIVITY OF SCORING

   a. May take time, but minimizes scorer judgment.
   b. Types:

(1) Examinee does it or does not do it; e.g., steps in a procedural task

(2) Presence or absence of essential attributes of a product: e.g.s:

----cooks pancakes to "golden brown"

----writes lesson plan to include. . .

(3) Time to complete a task

(4) Quantity of correct responses; e.g., number of target hits, or number of errors in performance

3. RELEVANCE

a. Basis is the behavior stated in the training objective.

b. If training objective is poorly stated must infer required job behavior by use of expert knowledge.

c. In attempting to reproduce job (T.O.) behavior in test:

(1) Usually means avoiding verbal tests

(2) Usually means avoiding multiple-choice tests; except where recognition is required behavior. E.g.s,

----selecting proper tool

----correct dial or knob

----which part of circuit to work on

(3) Reproduce behavior and conditions

Skills ⟶ Performance Test

Knowledges

(Reproduce) ⟶ List; Short answer

(Recognize) ⟶ Multiple choice; Identify

(4) Often some degree of simulation of conditions required.

(Ref. Reading and Discuss Rangeing-With-Binocular Example)

4. ANNEX A DISCUSSION

Period No. 46, Annex A

SAMPLE EXAMINATION ITEMS: TEST ITEM CHARACTERISTICS

Rate the following test procedures as acceptable or unacceptable on the three criteria: relevance, standardization, and objectivity of scoring. For each unacceptable rating identify what is wrong with that particular aspect of the test. Do not assume that the training objective is properly stated when you judge the relevance of the test item. Use your expert military mind to judge whether the objective is properly job-oriented or not, and evaluate the test procedure relative to your judgment of what the student-performance-objective should be. You will get 3 points for correctly rating the test--that is, 1 point on each of the three criteria. In addition, you will get 1 point for correctly identifying the fault on each criterion for which you judge the test unacceptable. So the total possible score on any one item may range from 3 points (it, the test, is acceptable on all criteria) to 6 points (if the test is unacceptable on all three criteria).

Terminal Performance Objective. Student must know how to range on a target using the binocular mil scale.

Test Procedure. Students are seated at tables. Before instructor hands out the test he states, "You will have 15 minutes to finish this test." The tests are then distributed. Instructions at the top of the test are: "Below are five problems. Each problem gives you the size of a target in feet and in mils. Using the mil relation you are to figure out the range to the target in meters and write your answer in the space provided." Each item scored as pass if answer is within plus or minus 50 meters of actual range.

Relevance: Not acceptable: Testing only on knowledge of arithmetic and knowledge of mil relation

Standardization: Acceptable

Objectivity of Scoring: Acceptable

Terminal Performance Objective. Given an M88 recovery vehicle and a tank mired in mud, student must be able to rig the tank for recovery within 30 minutes. Rigging must withstand the actual recovery operation.

Testing Procedure. The test problem is set up outdoors in a realistic situation, and is given to groups of three students. For each group of students, the tester states, "Your task is to rig that mired tank for recovery. I will handle the controls on the recovery vehicle and will follow instructions that you give me--except that I won't do anything that might be hazardous. You have 30 minutes to complete the task." Upon completion of the task, the tester inspects the rigging to see whether or not it meets the requirements and scores the students either "pass" or "fail."

Relevance: Acceptable

Standardization: Not acceptable: Each student not doing same thing.

Objectivity of Scoring: Acceptable: (Assuming that it would be too costly to actually test the rigging

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 47

LESSON OUTLINE

INSTRUCTIONAL UNIT: QUALITY CONTROL/CONCEPTS OF MEASUREMENT, TEST VALIDITY AND RELIABILITY

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Mr. William Osborn

TRAINING AIDS: None

REFERENCES: Osborn, W. C. and Cogan, E. A., Concepts of Measurement, Test Validity and Reliability (see Readings)

ASSIGNMENTS: Study references

OBJECTIVE: 1. Given a general description of a test procedure for evaluating student performance on a stated training objective, student a) lists three possible task conditions which must be considered in achieving content validity for the test, and b) describes the procedure for weighting these.

2. Given a description of a test procedure for evaluating student performance on a stated training objective, where the test procedure contains three deficiencies that would lead to unreliability; student must identify two of the three deficiencies and state how reliability could be improved.

Test Validity and Reliability

1. Content Validity.

a. Definition.
   (1) Relevance as characteristic of test item
   (2) Relevance as characteristic of total test
   (3) Content validity is stratified (representative) sample of job or of T.O.

b. Concept applied at all levels.
   (1) In-course enabling or terminal performances: emphasis is on sampling conditions of task performance
   (2) End-of-course, job performances: Emphasis is on sampling tasks

c. Two steps.

(1) Sources and types of information needed

(2) How use information to achieve content validity

d. Example of procedure for identifying tasks to be included in proficiency test for mechanic.

(1) Identify and define Frequency-of-Occurrence and Criticality-to-Mission categories:

e.g. Frequency-of-Occurrence

L = No more than once or twice per year

M = 3 - 6 times per year, Bn. size organization

H = Less than 6 times per year, Bn. size organization

Criticality-to-Mission

H = Necessary to carry out combat mission (100 miles, 15 hours)

L = Not necessary to carry out combat mission

(2) Given any data available (e.g., TARES), have job experts complete table below by filling in each block with an L, M, or H weight for both frequency and criticality.

		Fault Isolation	Correcting Action	Preventative Maintenance
	Engine			
	Exhaust			
M-60	Air Fuel			
TANK	Lights			
	⋮	⋮	⋮	⋮
	Suspension			

2. Reliability--Discuss and give examples of categories listed in reading.

3. Discuss Annex A.

Period No. 47, Annex A

SAMPLE EXAMINATION ITEMS: PART II, CONTENT VALIDITY AND RELIABILITY

Assuming that each of the following objectives and test procedures are acceptable, and assuming that more than one test item will be used in testing performance on each objective, list the task condition(s) which must be considered in achieving content validity of each test.

Enabling Objective. Given a view of a target in a realistic setting, student estimates the size of the target or of a near-by ranging object. Student must select either the target or an acceptable ranging object and report its width (or height) within ± 5% error.

Summary Test Procedure. Using slide projection, students are shown a photograph of a target in a realistic setting. Each student is required to write down 1) the object (target or other) upon which he will range, and 2) the estimated width (or height) of that object.

1. List two conditions that should be considered:

   a. Range to target (apparent size)
   b. Type of target
   c. Degree of concealment

2. Describe by example how you would determine which task conditions to include.

   Obtain experienced judgments of frequency and criticality for each type of each factor listed in (1) and then select most frequent and critical task-conditions for inclusion in test, e.g.:

	Type of Target		
	Tank	Antitank Gun	Bridge
Frequent	Hi	Med.	Med.
Critical	Hi	Hi	Low

Assuming that the following objective and test procedure are relevant, state two areas of weakness in the procedure which may lead to unreliability of the test, within any single administration of the test.

Terminal Performance Objective. Using an M14 rifle, student must be able to hit a target at a distance of 75 meters, at night; student must get off one round in 5 seconds, hitting the target 1 out of 2 times.

Test Procedure. Students are assembled at night on a rifle firing range, and each student is given an M14 rifle from stock. Students are briefed on the safety precautions, target characteristics, and complete test procedure. When his name is called, each student steps up to the firing station, and is given two rounds of ammunition which he loads. Student is told "ready," then, upon command of the tester, a pop-up, one-meter square target board appears for eight seconds at a distance of 75 meters. Student fires his two rounds at the target, and is scored as "pass" if one of the two rounds hits the target.

1. Test is too short.
2. Each student should use same rifle, or all rifles should be zeroed.
3. Possible fluctuations in amount of ambient light.

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 48

LESSON OUTLINE

INSTRUCTIONAL UNIT: QUALITY CONTROL/COMMUNICATION OF RESULTS

TYPE: Lecture, conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)
Annex B (one per student)

PERSONNEL: Mr. William Osborn

TRAINING AIDS: None

REFERENCES: Cogan, E. A., Communication of Results--Data Reduction, Analysis and Presentation (see Readings)

ASSIGNMENTS: Study reference

OBJECTIVE: Given the raw data from an end-of-course proficiency test, student prepares a summary report which has the following elements:

1. a list of students who qualify for graduation;
2. a graphic display of class performance, relative to standard performance, on each training objective tested;
3. a graphic display of weaknesses in enabling areas of any terminal objectives for which class performance was substandard.

1. Summarize Test Results.

<u>Example, Automotive Mechanic</u>

Performance Objective (Test Item)

STUDENT	1 Adjust Carb.	2 Replace Generator	3 Weld Fender	4 Trouble-shoot Light Circuit	------ . . .	10 Fill Out Parts Requisition Form	% PASS
1. ABLE	–	–	+	+	------	+	50
2. BAKER	–	+	+	–	------		60
3. CHARLES	–	+	–	+	------	+	85
4. DUNN	+	+	+	+	------	–	90
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
20. TERRY	–	+	+	+	------	+	80
% PASS	45	95	75	80	------	55	

N = Nr. Students = 20

2. Report Summary of Data for Student Qualification to Training Managers.

   a. Identifying information: Date, course, class nr., nr. of students.
   b. Qualification Data:
      (1) Per cent of students who qualify (met minimum standard)
      (2) Show class relative to past classes qualification rate
      (3) Possibly give guidelines (Quantitative) for management to classify "Failures" as either (a) remedial training, or (b) recycle

3. Report Summary of Data for Program Improvement to Trainers.

   a. Identifying info: Date, course, class nr., nr. of students.
   b. Diagnostic information:
      (1) Brief description of each test item
      (2) Per cent of students passing each test item
      (3) Guidelines for classifying performance on each test item

(i.e., indication of training adequacy for each training objective) as one of the following:

(i) Better than Required; perhaps can steal some training time from this particular objective and devote it to deficient area

(ii) Acceptable; performance within tolerances

(iii) Of Questionable Acceptability; let's see how next class performs on this objective before deciding to try to improve training

(iv) Unacceptable; must improve training in this area

Before recommending training improvement for an "unacceptable" category (iv) we want to be quite certain that the poor performance on this type of objective is not due to chance fluctuations. To be confident that performance was truly substandard on a particular objective may establish cutting lines (confidence limits) by the following method:

$$\pm 1.96\sqrt{\frac{PQ}{N}}$$

Where: P = Standard for passing (e.g., current administrative standard of .70)

Q = 1 - P

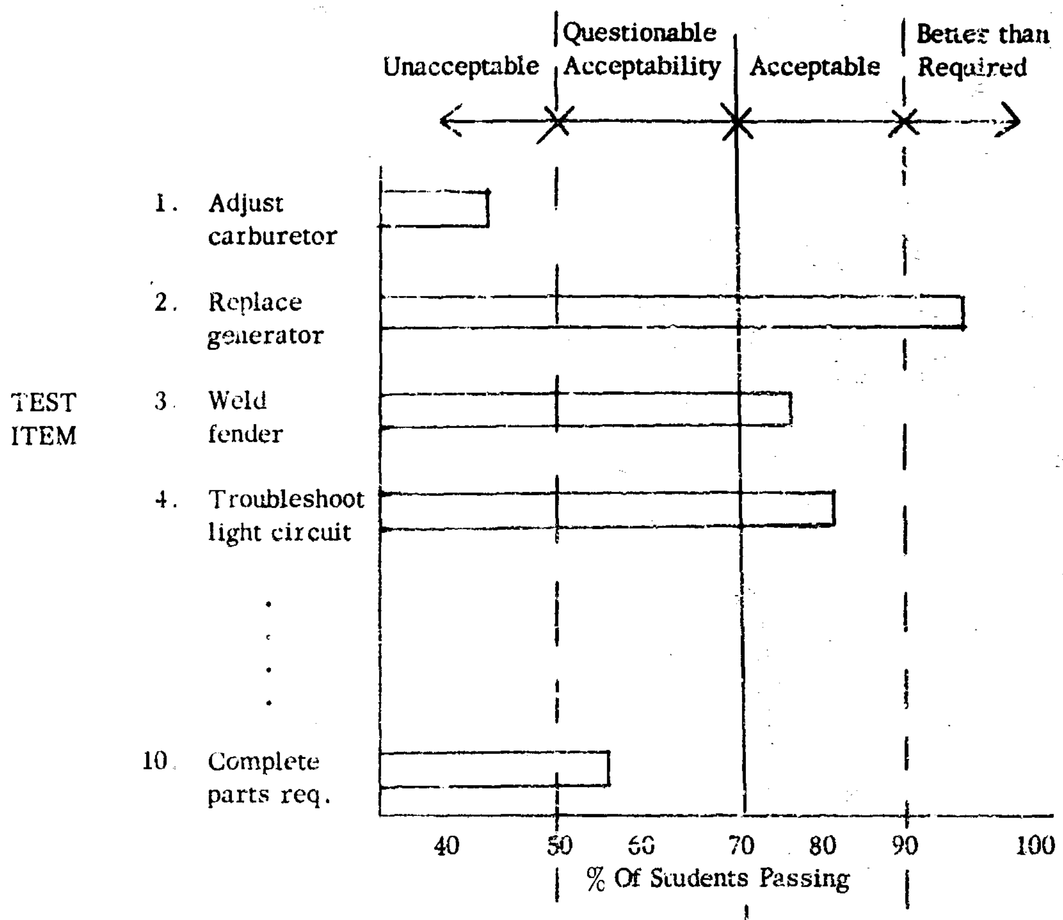
N = Number of students taking the test

1.96 = .025 point on sampling distribution of P

These limits may be placed around the standard and per cent performance on each item categorized as one of the four types, i, ii, iii, or iv. See Annex A.7

4. Finally, in reporting to those responsible for conducting training, you should point out the underlying sources of weakness for each terminal objective that has been classed as "Training is Unacceptable in this Area." That is, enabling skills and knowledges that were scored during testing on that objective should be reported so that the trainers know specifically where training is weak. (See Annex P.)

EXAMPLE OF DATA SUMMARIZATION FOR TRAINER'S USE IN PROGRAM IMPROVEMENT



$$-1.96\sqrt{\frac{PQ}{N}} \quad \Big| \quad +1.96\sqrt{\frac{PQ}{N}}$$

$$\pm 1.96\sqrt{\frac{PQ}{N}} = \pm 1.96\sqrt{\frac{.70(.30)}{20}}$$

$$= \pm .20$$

P = Administrative Standard

Period No. 48, Annex B

EXAMPLE OF DATA SUMMARIZATION FOR TRAINERS USE IN IDENTIFYING ENABLING WEAKNESSES FOR T.O.'S ON WHICH TERMINAL PERFORMANCE WAS SUBSTANDARD

--- Test area in which training was substandard: Carburetor adjustment

--- Of the 55% failing this test, the following per cent performance on enabling skills was observed:

	PER CENT PASS	PER CENT FAIL
1. Attempted to use T.M.	80	20
2. Found correct section in T.M.	75	25
3. Followed steps in T.M.	30	70
4. Isolated trouble to carburetor.	25	75
5. Attempted to use vacuum gauge.	90	10
6. Connected vacuum gauge properly.	80	20
7. Read vacuum gauge correctly.	65	35
8. Idled engine at correct speed.	60	40

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 49

LESSON OUTLINE

INSTRUCTIONAL UNIT: QUALITY CONTROL/EXAMINATION

TYPE: Examination

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Mr. William Osborn

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

Period No. 49, Annex A

QUALITY CONTROL EXAMINATION

Part I

Rate the following test procedures as acceptable or unacceptable on the three criteria: relevance, standardization, and objectivity of scoring. For each unacceptable rating identify what is wrong with that particular aspect of the test. Do not assume that the training objective is properly stated when you judge whether the test item is relevant or not. Use your expert military mind to judge if the objective is properly job-oriented or not, and evaluate the test procedure relative to your judgment of what the student-performance portion of the objective should be. You will get 3 points for correctly rating the test--that is, 1 point on each of the three criteria. In addition you will get 1 point for correctly identifying the fault on each criterion for which you judge the test unacceptable. So the total possible score on any one item may range from 3 points (if the test is acceptable on all three criteria) to 6 points (if the test is unacceptable on all criteria).

Enabling Objective. Given a series of distance measurements, student must be able to convert between miles and kilometers; the conversion being accurate to within ± 1% of the original measurement, 90% of the time.

Testing Procedure. Students are seated at tables in a classroom. Two forms of a paper-and-pencil test are distributed. Form A lists ten different kilometer readings, and Form B gives ten mileage readings. The tests are distributed, with half of the class given Form A and the other half Form B. The tester reads aloud the instructions: "On this test are listed ten distance measurements. These are designated as either miles or as kilometers. Those of you who were given mileage readings are to calculate the corresponding distance in kilometers and write your answer for each in the space provided. In the same manner, those of you given kilometer readings are to convert to miles. There is no time limit on this test; however, you should try to finish up in about 15 minutes. This is an "open book" test, and you may use any notes or computing aids that you have. You will be scored on accuracy, so carry your answer out to the second decimal--or to the third decimal if the given distance is less than either one mile or one kilometer." During scoring, the tester credits a student with passing an item if the conversion was made correctly to within ± 1% of the given distance; and he then scores each student as passing the test if no more than one of the ten answers was incorrect.

Points possible

2 Relevance: Unacceptable: Test should not allow for conversion rules. Should require memory.

2 Standardization: Unacceptable: Everyone should get same form or both forms.

1 Objectivity of Scoring: Acceptable

Terminal Objective. Seated at a typewriter with the necessary forms and reference manuals accessible; and given a five item list of supplies (type and quantity) to be requisitioned; student prepares four copies of the requisition DA Form 3161. The form should be completed in 30 minutes and sufficiently accurate to achieve acceptance and processing through supply channels.

Test Procedure. Students are assembled in a classroom and instructed: "Here is a list of items to be requisitioned from supply." (Tester hands out a copy of the list to each student.) "You are to go to your typewriter and prepare the necessary forms for requisitioning this list of supplies. All the necessary materials are located on the table by your typewriter. You will have 30 minutes in which to finish. If you are not finished when I call time, you should stop work anyway." At the tester's signal the students go to their typewriters and begin. Each typewriter is located in a separate cubicle where the students cannot observe one another. There is a variety of forms and reference material (a representative assortment such as would be available on the job) located in each cubicle. Student is scored as having passed the test if he used the proper requisition form, completed the task in the time limit, and made no serious spelling errors, and the completed form was neat and readable.

/ Relevance: Acceptable.

/ Standardization: Acceptable.

2 Objectivity of Scoring: Unacceptable: Emphasis should be on right items entered in right lines, and numbers accurate.

Terminal Objective. Using personnel data and without the benefit of first-hand observation of his men, student officer appoints a squad leader from among 8 men. The appointment should conform to the guidelines for "characteristics of potential leaders" prescribed in XFM 1000-1, and the selection should be correct 75% of the time.

Test Procedure. Students are seated in a classroom. Booklets containing the same information and answer sheets are distributed. The tester states: "The booklet before you contains personnel data summaries on four squads of eight enlisted men. Each summary contains the essential information from each man's 201 file. Assume that you have just been given command of a newly formed platoon of troops just out of AIT. You are to read over the profiles and select one man from each squad to act as squad leader. Write your selections on the answer sheet provided." The profiles for each squad were preselected so that one of the eight men had superior background characteristics for leadership as defined by "the book" (XFM 1000-1). Thus each student was scored as pass if at least three of his four selections conformed to the predetermined, best potential leader.

/ Relevance: Acceptable.

/ Standardization: Acceptable.

/ Objectivity of Scoring: Acceptable.

Terminal Objective: In a mock hand-to-hand combat situation, given an opponent using various attack positions, student demonstrates proper counter-blow or take-down action. Student must select a counter maneuver which, in 80% of the situations, is directed at opponent's vulnerable point, is executed aggressively and accurately without losing balance. (If trainee is working with a live opponent he should be cautioned to "pull his punches" and avoid risk of injury.)

Test Procedure. The test station is outdoors in a sawdust pit location. Students go through the station in pairs. After directing them to ground their equipment, the tester gives the instructions: "Here you will be tested on your skill in hand-to-hand combat.

One of you will act as the opponent while the other is being tested, then you will change roles. I will direct the opponent to take a certain position or action and then the man being tested should react as he has been trained to do. Execute your reactions sharply and accurately, but do not carry them through with full force. We don't want anyone injured." The tester then directs the opponent through a series of ten maneuvers, one at a time, and using his score sheet records the trainee's action or reaction to each of the ten. The procedure is repeated for the second trainee. Each response is scored as "pass" if the trainee a) chose a vulnerable point to attack, b) executed his action accurately and aggressively, and c) did not lose his balance. If the trainee passed eight of the ten test items he was scored as passing the station.

1 Relevance: Acceptable.

2 Standardization: Unacceptable: 2nd student can benefit from 1st student's performance.

1 Objectivity of Scoring: Acceptable.

Terminal Objective. Student must be able to carry out proper procedures for controlling the bleeding from an external wound at any location on the body with 80% accuracy.

Test Procedure. Students are seated in a classroom and test papers are distributed. The tester states: "Printed on your test are three outline views--front, side, and back--of the human body. The numbers 1 through 100 are printed at various points on the drawings. Below this are two columns. The first column is headed, 'Your buddy has blood flowing freely from a wound at this location,' and under this heading are listed twenty different numbers corresponding to locations on the picture. The column next to this is headed, 'You would apply pressure to this point,' and below this are twenty blank spaces, one for each answer. For each injury location given in the left column you are to find the point on the picture where you would apply pressure to contain the bleeding, and write that number in the blank to the right. There is no time limit on this test, but work right along--you should finish up in 15 or 20 minutes." Each student is scored as "pass" if at least 16 of the twenty pressure points are correctly identified.

2 Relevance: Unacceptable: Should test on skill in control of bleeding.

1 Standardization: Acceptable

1 Objectivity of Scoring: Acceptable

Part II

Assuming that each of the following objectives and test procedures are acceptable, and assuming that more than one test item will be used in testing performance on each objective, list the task conditions which must be considered in achieving content validity of each test.

Enabling Objective. Student must be able to convert between English and metric systems of measurement with 99% accuracy.

Summary Test Procedure. Using a paper-and-pencil test format, student is given a

measurement in one system and is required to calculate and write in the corresponding measurement in the other system.

List two conditions that should be considered (1 point each):

1. Given one, convert to other   3. Size of meas.

3   2. Type of meas. (linear, volume, weight, etc.)

Terminal Objective. Given a map and a field compass, student must be able to proceed from a designated starting point to a destination a minimum of 500 meters away, arriving within a specified time limit and within a specified deviation error.

Summary Test Procedure. Test is conducted outdoors on an individual basis. Procedure used is as outlined in the objective.

List three task conditions that should be considered (1 point each):

1. Day or night   4. Distance.

(3)   2. Terrain (visibility)

3. Diversions in route.

Terminal Objective. Student must be able to evaluate a proficiency test procedure, correctly identifying weaknesses in procedures with 75% accuracy.

Summary Test Procedure. Student is given a training objective and a corresponding description of a test procedure for evaluating student performance on that objective. Student must identify any inadequacies in the test procedure.

List three task conditions that should be considered (1 point each):

1. Relevance,   Skill vs. know. tests

(3) Agree by: 2. Standardization   or   Single vs. multiple behavior; Team vs. individual test.

3. Objectivity of scoring.   Group vs. individual administration.

Use a hypothetical example to describe how you would determine which task conditions to include, or what levels of each condition to include, or what mix to include for any one of the three test procedures given above. (6 points)

Have judges (experts) rate task conditions (and levels of task conditions) for:

(4) a. frequency of occurrence and,

b. criticality to mission.

	Criticality Hi	Criticality Lo	Frequency Hi	Frequency Lo
Light conditions				
— Day	✓		✓	
— Night	✓			✓
Terrain				
— Mountain		✓		✓
— Jungle	✓		✓	
— Desert		✓		✓
Diversions in Route				
— None		✓	✓	
— One	✓		✓	
— Two +		✓		✓

Assuming that the following objective and test procedure are relevant, state three areas of weakness in the procedure which may lead to unreliability of the test, within any single administration of the test. (2 points each)

Terminal Objective. Provided an operational M60 tank and a 7 meter tank-silhouette target, 1000 meters down range; upon command of the tank commander, student must be able to fire the main gun at the target, obtaining a second-round hit within 15 seconds.

Test Procedure. A target is placed 1000 meters down range (7 meter tank-silhouette target), in the same position for each student gunner. Each student is tested on the same M60 tank under the same tank commander. An AIT company of students are assembled near the testing area and briefed on range safety regulations, then told: "When your name is called you are to go over to the test tank there, and take your position at the gunner's station. When the TC gives you a fire command you are to engage and fire on the target. Fire no more than two rounds at the target. When you are through, return to this assembly area." Each student is scored as qualified if he obtains a first or second round hit within 15 seconds from the time the fire command is given.

1. Weapon out of boresight.
2. Emphasis speed vs. accuracy.
3. More than two rounds.
4. Students waiting should not see range.
5. Students tested should not return to area where others are waiting.

Part III (12 points)

You are the test officer in charge of the Proficiency Test section of G-3 in a training center. One of your duties is to see that the results of your testing programs are reported back to the training committees and company commanders responsible for the conduct of training. Below is a partial summary of the end of course proficiency test for a BCT company (Company A, 2nd Bn, 3rd Rgd). Here you are concerned with reporting to the company commander only those test areas for which he is the responsible trainer. Three of the ten test areas are of this type, namely:

1. Guard Duty and Reporting
2. Drill and Ceremonies
3. Physical Combat Proficiency

From the individual score sheets for A Company you have had the following table prepared. You now wish to prepare a further summary and interpretation for communication to the A Company CO, so that he can determine deficient areas of training as well as possible causes of deficiency.

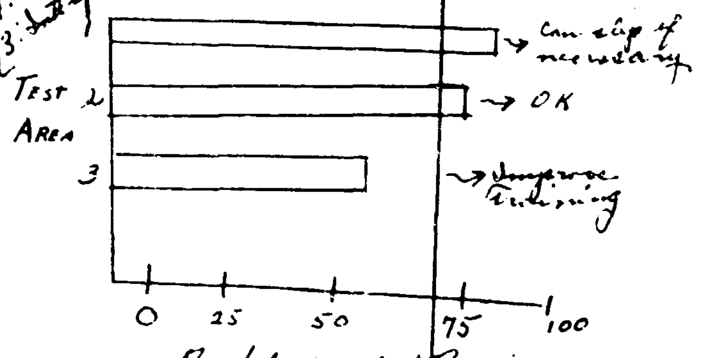
Based on the data given, prepare a short report to A Company CO. Include guidelines for determining training area strengths and weaknesses; also, if one of the areas is substandard, give a hypothetical example to illustrate how you would aid the CO in pinpointing the aspects of training in that particular area which he should concentrate on.

		Test Area 1	Test Area 2	Test Area 3
Trainee	1			
	2			
	.			
	.			
	.			
	200			
% of trainees passing		85%	75%	60%

Administrative Std: 70%

(1) Introductory Data
Class nr.
No. students
Date
Description of test items

(2) {4: Guidelines 3: Interpretation



% Students Passing
70% Standard
64% Minimum accept
76% Better than necessary

(4) Test area in which training substandard
Physical Combat Proficiency
Of the 40% failing this test, the following per cent performance on subtests:

	% Pass	% Fail
40-40 crawl	80	20
dodge-run	50	50
mile run	30	70
ladder climb	85	15
Grenade Throw	90	10

This table should be either handed out or put on board for reference in answering Part III.

If P =	and N =	then $\pm 1.96\sqrt{\frac{PQ}{N}}$ =
	3	$\pm$ .58
.60	10	$\pm$ .31
	200	$\pm$ .07
	3	$\pm$ .51
.70	10	$\pm$ .29
	200	$\pm$ .06
	3	$\pm$ .49
.75	10	$\pm$ .26
	200	$\pm$ .06
	3	$\pm$ .41
.85	10	$\pm$ .21
	200	$\pm$ .05

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 50

LESSON OUTLINE

INSTRUCTIONAL UNIT: QUALITY CONTROL/REVIEW OF EXAMINATION

TYPE: Conference

TIME ALLOTTED: 2 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A to Period 49

PERSONNEL: Mr. William Osborn

TRAINING AIDS: None

REFERENCES: Cogan, E. A., Case Study of Quality Control System (see Readings)

ASSIGNMENTS: None

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 51

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING MANAGEMENT RESPONSIBILITIES/DEPARTMENT OF THE ARMY FUNCTIONS

TYPE: Conference, practical exercise

TIME ALLOTTED: 6 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS:

AR 10-5:	Department of the Army (Published)
AR 10-7:	United States Continental Army Command (Published)
AR 10-11:	United States Army Materiel Command (Published)
AR 10-12:	United States Army Combat Developments Command (Published)
AR 10-40:	US Army Logistics Management Center (Published)
AR 70-17:	System/Project Management (Published)
AR 71-1:	Army Combat Developments (Published)
AR 615-1:	Manpower Management (Published)
AR 705-5:	Army Research and Development (Published)

PERSONNEL: Dr. Norman Willard
Dr. Robert Baker

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

OBJECTIVE: Student must be able to describe the responsibilities of each of the agencies in the Army training system

1. Class will be divided into eight equal groups. Each group will be responsible for reading the ARs appropriate to one of the following agencies and presenting their findings to the other members of the class:

a. Combat Developments Command
b. ACSFOR
c. Army Materiel Command
d. US Continental Army Command
e. Deputy Chief of Staff for Personnel
f. Deputy Chief of Staff for Logistics
g. Office of the Chief, Research and Development
h. Field Armies

2. The basis of the report will include the following areas of training management:

a. Performing systems analyses.
b. Determining human performance requirements.
c. Developing training objectives.
d. Specifying training standards.
e. Performing personnel selection.
f. Developing training programs.
g. Administering training programs.
h. Developing training aids and devices.
i. Developing training literature.
j. Performing quality control.
k. Miscellaneous training functions (specify).

HumRRO DIVISION NO. 2 (ARMOR)

TRAINING MANAGEMENT
Period No. 52

LESSON OUTLINE

INSTRUCTIONAL UNIT: TRAINING MANAGEMENT RESPONSIBILITIES/EXAMINATION AND REVIEW

TYPE: Examination, conference

TIME ALLOTTED: 4 hours

CLASSES PRESENTED TO: Armor Officer Advanced Course

TOOLS, EQUIPMENT, AND MATERIALS: Annex A (one per student)

PERSONNEL: Dr. Norman Willard

TRAINING AIDS: None

REFERENCES: None

ASSIGNMENTS: None

Period No. 52, Annex A

HumRRO RESEARCH PROJECT - ENLISTED MOS TRAINING OBJECTIVES

Reply to the following inquiry citing Army Agencies responsible for each problem area and providing an answer to each question:

1. Pursuant to authority contained in paragraph 27, CON Reg 350-1, it is requested that the Human Resources Research Office (HumRRO) conduct a research project to resolve the following problem: To what extent should "duties" and "skills and knowledges" be taught in MOS-awarding courses conducted by Army service schools, specifically MOS _______ and _______?

2. The major questions to be answered concerning this problem are as follows:

a. Should training prepare the student to perform every aspect of an MOS proficiently?

b. The utilization of the MOS description; i.e., "Duties" and "Skills and Knowledges" needs clarification. For example, should training, school or OJT, be confined to "duties" or "skills and knowledges," or should both be utilized?

c. Should every subject taught, relating to an MOS, be at the "qualified" level as defined in paragraph 19, Annex Q, CON Reg 350-1, dated 17 June 1964? If negative, how should the three levels of knowledge be applied?

d. Should the student be trained to perform proficiently duties, MOS-related, for a specific period of time? For example, should the course be geared to teaching the student those functions he will be expected to perform for the first six months of his duty assignment? If affirmative, how should this time frame be determined?

e. Should the student be trained to perform proficiently duties expected of a particular rank; for example, should the student be trained to perform the duties of an E-2, E-3, E-4, etc.? If affirmative, how will the rank be determined and how should the duties associated with a particular rank be determined?

f. Should all training be conducted at service schools or should some on-the-job training (OJT) be a prerequisite prior to awarding an MOS?

(1) If all training should be conducted at service schools, what considerations should be made as to length of time training should be conducted? For example, if it takes 26 weeks to fully qualify an E-2 having a 24-month active duty commitment, his productive time remaining would be little more than one year.

(2) If partial training should be by OJT, what considerations should be given as to the length of time school training and OJT should be conducted?

g. To what degree of accuracy should an enlisted man be able to perform upon the award of an MOS: 90%, 95% or 100%?

FOR THE COMMANDANT:

Appendix C

STUDENT APPRAISAL

TRAINING MANAGEMENT QUESTIONNAIRE

(Completed by 17 Students, AOAC #2, 23 April 1968)

1. How valuable do you think the Training Management Course was to you in increasing your understanding of Army training and its problems? (Check one.)

	Per Cent
a. The course was of great value in increasing my understanding of Army training and its problems.	53
b. It was of substantial value.	47
c. It was of only moderate value.	0
d. It was of little or no value.	0

2. To what extent do you think the principles and procedures taught in the Training Management Course could be applied to Army training? (Check one.)

	Per Cent
a. Almost all could be applied.	18
b. A large proportion could.	82
c. A small proportion could.	0
d. Almost none could.	0

2a. How valuable do you think it would be to Army training to employ these principles and procedures? (Check one.)

	Per Cent
a. It would be of great value.	82
b. It would be of substantial value.	18
c. It would be of only moderate value.	0
d. It would be of little or no value.	0

3. In 1966, the Haines Board recommended establishing an MOS for "Systems Analyst/Operations Researcher." If an MOS for "Training Manager" were proposed for inclusion in the Army Career System, how seriously would you consider it as a potential career for yourself? (Check one.)

	Per Cent
a. I would consider it very seriously.	35
b. I would consider it fairly seriously.	35
c. I would <u>not</u> consider it very seriously.	30
d. I would <u>not</u> consider it at all.	0

4. How valuable do you think the knowledge and skills you acquired in the Training Management Course would be to an Armor Officer, in performing the following (non-combat) assignments? (Check one for each.)

	Great Value (%)	Substantial Value (%)	Only Moderate Value (%)	Little or No Value (%)
a. Line Battalion: C.O.	29	59	6	0
b. Line Battalion: S-3	76	24	0	0
c. Instructor: Service Sch	71	24	6	0
d. Instructor: ROTC	41	41	18	0
e. Adviser: NG or Reserve	29	53	18	0
f. Adviser: MAAG	12	29	53	6
g. G-3 Staff (0-4 level)	59	29	6	0
h. Training Center: Bn C.O.	71	24	6	0
i. Training Center: Co C.O.	41	53	6	0
j. Training Center: Chief Instr	88	12	0	0
k. Line Company: C.O.	24	65	12	0
l. Line Company: Plat Ldr	12	41	41	6
m. CONARC Staff (0-4 level)	76	18	6	0
n. AMC Staff (0-4 level)	47	41	12	0
o. CDC Staff (0-4 level)	53	41	6	0

4a. How valuable do you think the same Training Management knowledge and skills would be to an Armor Officer in performing the following combat assignments? (Check one for each.)

	Great Value (%)	Substantial Value (%)	Only Moderate Value (%)	Little or No Value (%)
a. Line Battalion: C.O.	6	53	24	18
b. Line Battalion: S-3	24	47	24	6
c. Line Company: C.O.	12	35	35	18
d. Line Company: Plat Ldr	6	29	47	18

5. Students in the AOC Course usually regard their training in "Tactics" or "Automotive" as the most valuable part of all their AOC instruction. How valuable do you think the Training Management Course was, as compared to "Tactics" or "Automotive"? (Check one.)

	Per Cent
a. It was just about as valuable.	65
b. It was a little less valuable.	18
c. It was a good deal less valuable.	12
d. It was much less valuable.	0
No Response	6

6. How valuable do you think each major block of instruction was in increasing your understanding of Army training and its problems? (Check one for each block.)

	Great Value (%)	Substantial Value (%)	Only Moderate Value (%)	Little or No Value (%)
I. Systems Analysis and Management	24	47	29	0
II. Training Analysis	65	35	0	0
III. Training Program Development	76	24	0	0
IV. Quality Control of Training	59	41	0	0
V. The Army Training System and its Functions	41	41	18	0

7. Stated below are the general objectives for each of the five major blocks of instruction in the Training Management Course. Please read each statement carefully; then indicate to what extent you think each block of instruction fulfilled its objective as stated. (Check one for each block.)

Block I. Systems Analysis and Management

Objective: To provide the student with a knowledge of the functions and structure of modern, complex systems; the major problems of managing such systems; and the general relevance of system analysis and management theory to Army training.

The objective for Block I was fulfilled:	Per Cent
Very Adequately	12
Fairly Adequately	59
Somewhat Inadequately	29
Very Inadequately	0

Block II. Training Analysis

Objective: To enable the student to analyze a training system and a training mission in order to: (1) determine the human performance requirements; (2) allocate functions and assign duties to the system components, i.e., men and machines; (3) perform a job analysis and determine the knowledge and skill requirements; (4) determine the student performance objectives; and (5) supervise others in the preparation of training objectives.

The objective for Block II was fulfilled:	Per Cent
Very Adequately	65
Fairly Adequately	35
Somewhat Inadequately	0
Very Inadequately	0

Block III. Training Program Development

Objective: To enable the student to review Army Subject Schedules, Lesson Plans and support documentation pertinent to training program development and administration, with particular reference to: (1) the adequacy of prerequisites, course sequencing and trainee performance evaluation; (2) the effectiveness of the media specified for course presentation; (3) the inclusion of techniques for optimizing the efficiency of instruction; and (4) the utilization of supporting literature and instructional aids.

The objective for Block III was fulfilled:	Per Cent
Very Adequately	35
Fairly Adequately	59
Somewhat Inadequately	6
Very Inadequately	0

Block IV. Quality Control of Training Systems

Objective: (1) To enable the student to evaluate proficiency tests in terms of relevance, standardization, objectivity of scoring, and other factors that affect content validity and reliability; (2) to enable the student to summarize and communicate test results for use in the management activities of student qualification and training program improvement.

The objective for Block IV was fulfilled.	Per Cent
Very Adequately	41
Fairly Adequately	53
Somewhat Inadequately	6
Very Inadequately	0

Block V. The Army Training System and Its Functions

Objective: To provide the student with knowledge of the training management obligations and responsibilities of a number of Army agencies and commands, e.g., CDC, AMC, CONARC, OCRD, DCSLOG, DCSPER, DCSOPMS, ACSFOR, and the Field Armies. The extent of overlap in responsibility and the degree of mission conflict between these agencies and commands is also evaluated.

The objective for Block V was fulfilled:	Per Cent
Very Adequately	35
Fairly Adequately	59
Somewhat Inadequately	6
Very Inadequately	0

8. In "feedback sessions" with other classes, various suggestions have been advanced for improving the Training Management Course. Do you agree or disagree with the following suggestions? (Check one for each.)

	Agree (%)	Disagree (%)	No Response (%)
a. Use a textbook	35	59	6
b. Use a book of readings	65	35	
c. Use a detailed course outline	88	12	
d. Use a list summarizing the major points covered	82	18	
e. Use more military examples	94	6	
f. Use one instructor for all blocks	24	76	
g. Use a uniform vocabulary	88	12	
h. Put entire course on film or TV tape	0	100	
i. Use fewer non-military examples	47	53	
j. Use less theoretical material	47	53	
k. Make less use of "divergent viewpoints"	24	71	6
l. Formulate more relevant training objectives	71	29	

(Continued on B)

	Agree (%)	Disagree (%)	No Response (%)
m. Formulate more understandable training objectives	71	24	6
n. Use more practical exercises	76	24	
o. Use more training aids	29	71	

9. Please use the space below for any further comments or suggestions you would like to make about the objectives, contents, procedures, value—or any other aspect—of the Training Management Course or its individual blocks. (If you need additional space, continue on the back of this page.)

Appendix D

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PUBLISHED REFERENCES

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Appendix E

READINGS

Contents

The Army's Training Mission

Robert A. Baker
HumRRO Division No. 2

"My Army is not unlike my insurance program. The people of America will never accrue a profit on its operation—except when the chips are down and protection of all they hold near and dear is demanded and paid for in human sacrifice. Then and only then do they who buy such insurance realize a return on the investment they made when they enjoyed their national health."

.... Colonel Oscar C. Buser

Through the Secretary of Defense and the Secretary of the Army, the President has assigned to the Army the mission of providing security for the nation and assisting him in supporting its national and international policies. To accomplish this mission, the Army must be ready at all times to undertake combat operations and sustain them indefinitely.

Traditionally, the policy of the United States has been to maintain an Army of minimum size consistent with our immediate needs. This force, nevertheless, must be capable of rapid expansion in the event of a national emergency. Because time is critical during mobilization, training requirements during that period must be reduced to essentials. Peacetime training must serve to determine which requirements are essential and to provide a force ready to train the manpower needed to provide a force ready for immediate combat in the event of a sudden attack. Responsibility for the training of all components of the Army is assigned to the Department of the Army. Its training missions include:

1. Achieving and maintaining a state of training that will insure the capability of prompt and sustained combat operations on land.
2. Maintaining a trained mobilization base for expanding the active Army when necessary.
3. Developing tactics and techniques for all Army combat and service elements.

While these are the Army's general training missions, the objectives are specified in somewhat more detail in Army Regulation 350-1.[1] Here the mission is analyzed and broken down in the form of specific training objectives:

1. Training of all individuals in the required military occupational specialties (MOS) for the current commitments and for the planned establishment.
2. Training of all units of the Army to include joint training and special training (where appropriate to the assigned missions).
3. Training of individuals and units of the Reserve components of the Army, who are not on active duty but are required in the event of mobilization.
4. Maintenance of an adequate and progressive military school system.
5. Maintenance of training installations and facilities adequate for training individuals and units for the planned establishment and, within limitation of available funds, capable of rapid expansion to support full mobilization.

Further objectives include the training of key specialists and cadres for the maintenance of an adequate mobilization troop basis, the teaching of individuals, missions, and detachments for service in foreign countries, the training of selected individuals of allied nations in U.S. Army tactics and techniques, as well as joint cooperation and tactical training with the Navy, Air Force, and the forces of allied nations.

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To aid in the attainment of these various objectives, the Department of the Army prepares general and basic Army-wide training policies and then issues periodic directives for implementation. Training given by individual Army units is then based on the directives received through the chain of command and is conducted according to a series of guides. These guides include Field Manuals (FMs), Army Training Circulars (TCs), Army Subject Schedules (ASubjScd), and Army Training Tests (ATTs) for specific units.

In carrying out the Army's training mission, the responsibility for implementation is assigned to two major command groups—the overseas Army commands and the U.S. Continental Army Command (CONARC).

Overseas Army commanders are responsible for conducting the training of troops assigned to their commands in accordance with Department of the Army doctrine as set forth in official training publications. They are also responsible for determining and executing training requirements generated by operational missions, and for maintaining their units in a high state of combat readiness. The overseas commanders discharge these responsibilities by preparing appropriate plans and policies, by issuing the directives and training publications needed to accomplish the established training missions and by supervising the training activities of subordinate units. Similarly, the Commanding General, U.S. Army Air Defense Command and the Commanding General, U.S. Army Security Agency are responsible for the training of troops under their commands. In instances where Army troops are an integral part of a joint command, the Army component commander is responsible for the Army component of the joint command. All training conducted in these commands, however, is based upon standards and doctrine promulgated by Department of the Army.

The Commanding General, U.S. Continental Army Command (CG, CONARC) is charged with the training and training inspection of the Army in the field.[2] He is responsible for the training of the six Armies within the continental United States, the Military District of Washington, and other units, activities, and installations which may be assigned or attached. He is also responsible to the Chief of Staff of the Army for certain specified functions pertaining to the Army in the field to include:

1. Reviewing, developing, recommending, and testing new and revised organizations, doctrines, and techniques.
2. Preparing training literature and training aids.
3. Teaching tactical, administrative, intelligence, and logistical doctrine and techniques.
4. Training within the continental United States to meet Department of the Army training objectives, including the combat, service, and technical training of the active field Army.

These responsibilities are carried out through the preparation of plans and the establishment of policies for accomplishing the required missions. Specific instructions and guidance to the various units and commands for the conduct of training are given in the CONARC Training Directive.[3] This directive includes training policies and procedures of wide applicability and general nature, and covers such topics as training responsibility, training organization and policy, specialized training at the individual and unit levels, education and training in the Army Service Schools, training of Reserve components, and training administration and support procedures.

Commanders of commands that are immediately subordinate to CONARC are held responsible for implementing these broad policies in the directive as well as for conducting specific kinds of training necessary to accomplish the assigned training mission.

Within each subordinate command the unit commander[4] is held responsible for training his unit to perform its assigned missions. Within the limits of the directives and policies of higher headquarters, he specifies what training is to be conducted and charges his staff and subordinate commanders with its accomplishment. He is responsible for

insuring that the performance, maintenance, and proficiency standards used are consistent with Department of the Army policies and, when necessary, he issues training directives, orders, or memoranda appropriate to the instruction or information to be disseminated.

THE ARMY TRAINING SYSTEM

In order to fulfill their assigned responsibilities and to carry out their assigned missions, the Department of the Army and the various subordinate commands have, over the years, developed a highly complex training system, yet one that is simple in theory. Thus, all training being conducted by active Army or Reserve component units at any given period can be appropriately placed in one of three major categories—individual training, unit training, and combined arms team training. These categories were established primarily for convenience in planning as well as to indicate definite stages of progress.[5]

Individual training begins when a soldier enters the Army and continues throughout his time of service. At the outset, emphasis is placed on individual training in the basic military skills. At a later stage, the emphasis is shifted to teaching him the primary skills of a military occupational specialty and training him for a specific duty assignment within a unit.

Unit training, on the other hand, is concerned with training the individuals to function as members of a team or unit. It attempts to integrate the smaller units into coordinated battlefield teams within respective Army branches, such as Armor, Infantry, or Artillery. These units develop their tactical proficiency, perfect their operating procedures and their employment of their manpower, weapons, and equipment. Unit training, however, continues to emphasize individual training by providing the opportunity for the individual soldiers to learn the value of teamwork, and to practice their individual skills. Moreover, advanced training is continued for all leaders, as well as for all specialists whose duties require additional training during the development of unit proficiency.

Combined arms team training is generally initiated in the early stages of unit training and continues as a major area of emphasis throughout the development of units—from platoon through army level. Occasionally, in the advanced stages of this training, joint training exercises or maneuvers are conducted which serve to insure the existence of trained and balanced forces necessary for major operations in the event of an emergency.

1. Individual Training.

Broadly conceived, the purpose of individual training is to familiarize the new enlistee or conscriptee with his surroundings and to acquaint him with his responsibilities as a soldier. During this period, he receives short orientations on what is expected of him during his service and what he may expect from the Army. The commander responsible for the initial conduct of individual training makes every effort to eliminate personal problems and bring about a rapid adjustment on the part of the new man. Practice, drills, and physical training are given in order to develop discipline, coordination, and teamwork. The specific purpose of all this training is to instill in the new soldier precise and orderly habits. As he progresses the recruit develops proficiency in weapons, first aid, marksmanship, maintenance of his individual equipment, and other military subjects. When he is provided with a firm foundation in the fundamentals, his training is then directed toward the development of skills in a particular military job. It is assumed that with application of knowledge and skill in later phases of training, a high degree of proficiency will result.

In order to maintain the operational proficiency of the active Army units, branch qualified soldiers and specialists must be trained to replace personnel losses. The purpose

of this replacement training is to provide new soldiers with basic military knowledge and to develop their proficiency for a specific duty assignment within a TOE[6] unit. The trained replacement should be physically conditioned, technically qualified, and emotionally prepared to perform successfully in combat operations. The aim of such training is to provide a continuous flow of qualified basic soldiers, as individuals or in packets of variable size to units in combat on overseas duty or to units conducting peacetime training missions in the continental United States.

This replacement training, or cycle, consists of two phases—Basic Combat Training and Advanced Individual Training. In order to insure standardization of training and the qualification of replacements for service overseas, the Department of the Army has established mandatory training requirements in time and subject areas (Army Regulation 612-35[7]). In addition, in order to insure that all soldiers going into combat have been properly trained, Public Law 51, passed by the 82nd Congress, requires that

"... *no such person shall, during this four months period, be assigned for duty at any installation located on land outside the United States ... and no other member of the Armed Forces of the United States who is enlisted, inducted, appointed, or ordered to active duty ... shall be assigned to duty at any installation located on land outside the United States ... until he has had the equivalent of at least four months of basic training....*"

a. **Basic Combat Training (BCT).** In this phase of training, all enlisted men without prior military service—inducted or enlisted—in the Army receive the training prescribed for this phase as outlined in Army Training Program 21-114. This training is now eight weeks in length. This initial stage of individual training has the objective of training the newly inducted soldier in the fundamentals of soldiery including basic infantry formations and battlefield survival *with the further aim of preparing him for additional individual training in a designated branch.* Some of the specific objectives to be attained include:

(1) An understanding of, appreciation for, and confidence in the achievements and traditions of the Army.
(2) Appreciation of military courtesy and customs.
(3) Moral responsibility in military service.
(4) An understanding of the individual's role in the Army.
(5) Physical health, stamina, and agility.
(6) Personal hygiene.
(7) A sense of confidence in weapons.
(8) An understanding of the basic fundamentals of combat operations.

b. **Advanced Individual Training (AIT).** The second eight-weeks stage of individual training—advanced individual training—completes the mandatory replacement training cycle. The broad objective of this training phase is to develop within the individual a general knowledge of the organization, mission, and functions of the unit within the branch to which he is assigned, and to qualify him to perform duties in a military occupational specialty (MOS). Specific objectives to be accomplished are outlined in the appropriate Army Training Program (ATP) for the unit, supporting Army Subject Schedules (ASubjScd), or in the appropriate Programs of Instruction (POI) of the service schools. This phase of training is usually conducted in training centers, service schools, or TOE units, and may be accomplished by on-the-job training, schooling, or a combination of these. Upon successfully completing this phase of training, individuals are awarded the MOS for which they were trained (MOS duties and qualifications, skill levels, etc., are spelled out in AR 611-201[8]). The individuals are then considered to be qualified for assignment as replacements to the appropriate units having need of their particular MOS skill.

Subsequent to the completion of the replacement training cycle, any individual found to be deficient in his primary MOS will, in theory, be retrained until he reaches the proper proficiency level. In the event retraining is impractical, a new primary MOS will be assigned—theoretically, one that is commensurable with his demonstrated capabilities and qualifications according to appropriate personnel procedures.

2. Unit Training.

As in the case of replacement training, training to develop a unit's proficiency is accomplished in two stages. The purpose of the first stage is to attain an adequate status of operational proficiency in a minimum of time through the conduct of the formal phases of cycle training. The second stage is aimed at the maintenance of a maximal operational readiness, as time permits, through the conduct of post-cycle training requirements.

The formal phases of cycle training are conducted in sequence as follows:

a. **Basic Unit Training Phase** (BUT). The purpose of basic unit training is to train skilled individuals to coordinate their efforts toward the accomplishment of unit missions. This phase provides an opportunity for the soldier to learn the value of teamwork and to apply, in practice, the skills he acquired in advanced individual training. The team training should be conducted in a progressive manner, beginning with the development of the squad, then platoon, followed by company-sized team training. During this phase, combined arms training is initiated to develop fully the functional concepts and capabilities of each team. Normally ten weeks long, the training to be given during this phase and in the advanced unit phase is specified in the appropriate unit Army training program.

b. **Advanced Unit Training Phase** (AUT). The 10-week advanced unit phase, integrates the company-sized teams (now supposedly capable of accomplishing their TOE missions) into the coordinated units (battalion or battle group) within their respective branches. Emphasis is placed on the development of tactical proficiency, operating procedures, combined arms training, and proper utilization of manpower, weapons, and equipment. On completion of this phase of training, the battle group or battalion should have attained—as a minimum—a satisfactory standard of operational proficiency and should be able to undertake combat operations.

c. **Field Exercise and Maneuver Phase.** The field exercise and maneuver phase provides for the training of large units under simulated combat conditions. This period provides the opportunity for the battle group or battalion to become fully capable of operating as a separate combat unit or as a part of a larger force. Such maneuvers usually involve many types of units in order to insure the maximum effectiveness of the combined arms training. The training conducted in this phase is prescribed in AR 220-55[9] and ATP 20-5.[10]

d. **Post-Cycle or Operational Readiness Training.** Post-cycle training is defined as that stage of training undertaken by units that have completed the formal phases of cycle training and that are not immediately designated for a combat role. This phase provides an opportunity for the small unit commander (squad, platoon, and company) to perfect his combat readiness and to improve teamwork. The objective of this phase is to retain unit capability to engage in immediate combat operations related to specific operational missions. Entry of units into this phase of training and the specific training needed is usually determined by the major commander concerned. During this phase, training deficiencies are corrected and specialized training is conducted as required. The specific training programs may include portions of any of the formal phases described above. Moreover, major commanders may delegate the authority to modify Army training programs and tests for units undergoing operational readiness training to assure that

appropriate latitude is afforded to conduct that training most conducive to the maintenance of combat readiness and the accomplishment of specifically assigned missions.

TRAINING AND THE ACTIVE ARMY UNIT

Although cycle training consists of definite phases, there is no distinct boundary between them. Rather, each is designed to blend into the succeeding phase. In fact, training is conducted throughout the life of a unit. The nature of the training depends upon the type of unit, status of training, and its mission. The life of a mobilized or active Army unit can be divided into logical stages and, normally, follows a definite sequence. Training requirements and objectives exist in each of these stages; commanders and staff officers must be aware of their existence if they are to achieve any measure of success during mobilization periods.

1. **Activation and Organization.** When a new unit is to be activated, the Department of the Army designates the unit and the effective date and place for activation. Concurrently, additional instructions are issued to indicate what unit is to provide the cadre (the key group of leaders and specialists needed) and to designate the commander and key officer personnel.[11] Plans are then initiated for the conduct of training of the unit. A cadre training program must be prepared and implemented upon the arrival and assignment of the cadre in preparation for the conduct of the ATP cycle training. Prior to the receipt of the filler personnel, a precycle filler training program must be developed to assist in the adaption of these personnel to Army life. Plans must be made to prepare and implement the basic combat training program immediately after the activation ceremonies.

2. **Training.** During this stage, individuals and units are trained to the desired level of proficiency. The Army training program cycle is conducted to insure development of the unit's capability to accomplish its assigned mission. Upon completion of cycle training, operational readiness training is initiated prior to beginning the movement of the unit.

3. **Pre-Embarkation and Movement.** Training in the early portion of this period is usually undertaken to correct any remaining deficiencies, to maintain the physical conditioning of the troops, and to perfect unit operations to the extent that time permits. Additional training covers the preparation of the unit for execution of loading and lashing, packing and crating, and other movement requirements. This stage also includes orientations on shipboard or air movement procedures, and the troops are provided all relevant and available information about the area to which they are going and about the enemy.

4. **Overseas Staging.** In oversea staging areas, units make final preparations for combat readiness. In this period, all personnel and equipment requisitions are filled and an intensive refresher training program is implemented. This training may include physical conditioning, indoctrination and integration of replacement personnel, zeroing weapons, familiarization training on any new weapons or equipment introduced, orientation on new enemy techniques and tactics, reviewing small unit tactics, and perfecting staff operating procedures. The preparation to complete combat readiness may be finished in the zone of the interior in the event that initial combat operations climax a shore-to-shore movement.

5. **Combat.** This stage, obviously, constitutes the ultimate evaluation of the training given in all previous stages. Even during combat, however, on-the-spot training is frequently conducted to remedy observed operational deficiencies, to integrate personnel and equipment, and to improve operating procedures.

6. **Occupation.** Training is also conducted in overseas occupation areas in order to maintain the operational proficiency of the unit and to prepare individuals and units for any special requirements needed to carry out their occupational duties.

7. **Inactivation.** Finally, training is conducted by the Army to prepare individuals either for return to civilian life or for reassignment to other units.

ARMY SERVICE SCHOOL SYSTEM

As noted earlier, one of the major training missions assigned to the Commanding General, U.S. Continental Army Command, is the responsibility for the supervision and control of the Army Service School System. At present, this system consists of 28 schools and serves to meet Army-wide requirements for trained commanders and specialists. The courses of instruction are controlled by CONARC or other Department of the Army agencies. The student body is selected and assigned directly by the Department of the Army, or by units, on the basis of space available or mandatory unit quotas. Units usually attempt to take full advantage of their school quotas in order to have a ready source of expertly trained replacements for critical specialists positions.

In selecting personnel for attendance at service schools, the commander usually considers the individual's potential ability to teach others as well as his ability to pass or complete the course of instruction. Such a selection policy is intended to provide a unit with its required number of school-trained specialists as well as unit instructors capable of teaching the latest Army doctrines and techniques. Courses offered in the Army schools and the general provisions of the Army's school system for the education and training of individuals are described in AR 350-2,[12] and AR 350-5.[13]

In addition to the service schools, individual units or commands frequently organize and operate their own schools to meet local training requirements that lie outside the province of Army schools. For example, high-speed radio operator schools, supply schools, and clerk-typist schools are commonly conducted at division level. Driver schools, instructor training schools, and mess management schools are normally conducted at battle group or battalion level. Officer and NCO schools may be conducted at any level. The authority and guidance for establishing noncommissioned officer academies at division and comparable levels is contained in AR 350-90.[14] Unit schools are normally operated for a limited period of time and for a limited number of men whose training requires special knowledge, techniques, facilities, or equipment. The headquarters of the unit establishing the school usually determines who will attend it.

In summary, and although some would argue that it is a vast oversimplification, one can regard the Army Training System as a means for carrying out the Army's training mission which consists of three broad and major assignments: a) replacement training, b) mobilization training, and c) the maintenance of combat readiness. The test of the effectiveness of any training effort should be, simply, the extent to which the effort contributes to the successful completion of any of the Army's three broad missions. In the words of Lieutenant General Paul D. Adams,[15] these three missions can be stated quite simply:

> "**Replacement Training**--A recruit in training is a replacement; an officer in a school is a replacement for someone somewhere when he finishes school; as is the specialist being created at one of the service or technical schools.
>
> "**Mobilization Training**—Mobilization training is the entire course of training given a raw unit commencing with the first steps of basic individual training and extending through field exercises and maneuvers. The product is a new combat unit ready for shipment to a theater of operations. This training is called the Army Training Program Cycle, or simply cycle training. It includes

five phases: 1) basic combat training; 2) advanced individual training; 3) basic unit training; 4) advanced unit training; and 5) field exercises and maneuvers.

"Maintenance of Combat Readiness—Maintenance of combat readiness is the kind of training that the Strategic Army Corps (STRAC) units must do at home, the Seventh U.S. Army must do in Europe, and the Eighth U.S. Army must do in the Far East."

[1] *Education and Training: Army Training.*

[2] The term "Army in the field" refers to the individuals and units of the Army intended for use in a theater of operations.

[3] *CONARC Training Directive*, Headquarters, U.S. Continental Army Command, Fort Monroe, Virginia, 1 July 1961.

[4] A unit is defined as any military element whose structure is prescribed by an authorized table of organization and distribution.

[5] These three general categories have been and often are further subdivided into phases of training, depending largely on the type of organization, its mission, and the existing state of training.

[6] TOE—Table of Organization and Equipment, i.e., an "active" Army unit.

[7] *Personnel Processing. Preparation of Replacements for Oversea Movement (POR).*

[8] *Enlisted Military Occupational Specialties.*

[9] *Field and Command Post Exercises.*

[10] *Army Training Program for Field Exercises and Maneuvers.*

[11] Prior to reporting, the officer personnel are normally provided the opportunity to attend service schools to receive refresher instruction in the latest doctrines and techniques.

[12] *Selection, Administration, and Assignments for Officer Students to Service Schools.*

[13] *Military Education and Schools.*

[14] *Noncommissioned Officer Academies.*

[15] Opening remarks by Corps Commander, V U.S. Army Corps, V U.S. Army Corps Training Conference, 15 March 1960.

The Determination of Goals and Objectives

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The first step in developing training objectives is to analyze and describe the relevant operational system, organization, suborganization, or team to which the students will go upon graduation. There are two major reasons for starting the process of developing objectives with a system analysis:

First, it is necessary to gain an overview of the operational context of the job in order to reduce the possibility that errors will be made in describing the job. A number of instances have occurred in which major parts of a man's job have been left out of a job description. The overview also helps to identify possible aids for making short-cuts in some of the later steps in the process of developing objectives. For instance, manuals that describe *procedures* in detail may provide a good working basis for a detailed description of job duties.

Second, a system analysis is needed to relate the activities of the job-holder to the mission of his organization, and thus to increase the likelihood that the objectives will reflect the significant mission requirements of the system.

There is extensive literature in the field of system analysis, but much of it deals with the type of analysis required for system design, rather than analysis of existing systems for the purpose of developing training objectives. Here a simplified type of system analysis will be described which is suitable to the topic of developing objectives.

In this application of system analysis, there is a requirement to develop the following information in general terms:

(1) The purpose of the system, as reflected in statements of system missions and goals.

(2) The major components of the system, including both men and equipment. Under this heading the functions of each component are described, as well as interactions between the components.

(3) The environment of the system (whether indoors, outdoors, or in dangerous areas).

(4) A mission profile, work flow chart, or outline of duties, showing generally what each person in the system does in each of the major phases of each mission.

After the training mission has been received and the training system analyzed or, through experience, thoroughly understood, the training manager is faced with the problem of preparing a training program. Before this can be done, however, he must answer some questions: What is the training for? Why are we going to all this trouble? What are the goals we wish to accomplish? If we put an untrained man through a training program, what do we expect the finished or trained man to be like at the end of the program? The answers to such questions must be obtained before work on any training program can begin. A full description of what the trainee will be like, what he will and will not be able to do, when his training is complete must be stated clearly and unambiguously *at the outset.* A full and carefully worded series of statements telling the kind of things the trainees will be able to do, the conditions under which they will carry out their activities, and the degree or extent of their skill in performing the required tasks make up the *human performance requirements* or *training objectives* for our training programs.

There are two explicit purposes, or course objectives for this section of the workshop in training management programs: One, how to determine the goals and objectives, that is, the student performance objectives for a training program, and, two, how to supervise others in the preparation of these sorts of system training objectives.

In chronological sequence the first decision the man responsible for training may be called upon to make is the decision to establish and conduct an appropriate training program—a program that will teach something. This raises three questions:

(1) Can an untrained man do the job?
(2) Can he follow printed instructions?
(3) Does the job merely require that he take and follow orders?

Once a positive decision is made, the man responsible for training must then decide upon the goals he intends to reach at the end of the course, unit of instruction, or program. Then he must select procedures, content, and methods which are relevant to the objectives, things that will cause the student to interact with appropriate subject matter in accordance with the principles of learning, and finally he must measure or evaluate the student's performance according to the objectives or goals originally selected.

The first of these decisions, the *proper description of objectives*, is a KEY subject. Since we are interested in preparing TPs that will help us reach our objectives, we must first be sure our objectives are clearly and unequivocally stated. We cannot concern ourselves with the problem of selecting the most efficient route to our destination until we know what our destination is. In this regard, an ancient bit of philosophy is highly relevant: *If you don't know where you're going, any road will take you there.* Not only is it of paramount importance to know what you are trying to do and where you are going, it is of equal importance that you let your horses know also.

If you alone are involved, there is no problem. Today, however, in most organizations there are many levels of control—a long-extended chain of command. Without clear, unambiguous communication, there cannot be unity of effort toward a common goal.

Although the vital role of communications in business is unquestioned at the public relations level, the importance of communications in training management—from manager to trainer and from trainer to trainee—is no less vital.

Because of the ever-present dangers of misunderstanding, misinterpretation, and confusion, there must be a clear specification of:

What is to be done
Why it is to be done
Where it is to be done
By whom it is to be done
At what time it is to be done
And to what extent, degree, or level of perfection it is to be done

if the training effort is to be properly focused and properly conducted. *All* of these things must be communicated by the training manager to his training staff, by the staff to the instructors, by the instructors to the assistant instructors, and by both of the latter to the trainees.

Too many instructors are unaware of the need to communicate their objectives clearly to others. Yet this is one of the principal reasons why objectives must be clearly stated.

Students comprise the one group with whom clear communication is essential. They spend a great deal of time and effort trying to find out what the instructor *really* wants them to learn. Instructors are frequently asked such questions as, "Do you really want us to learn this?" "Will this be on the test?" "You spent a lot of time on this last period, but it wasn't covered on the test at all." If the students know exactly what they are expected to learn, they will save the time otherwise wasted in trying to find out or guess, or possibly studying the wrong material.

The training course or program objectives must also be communicated clearly to the instructors. In training matters within his sphere of authority, nearly every instructor has his own approach and his favorite examples and illustrations. Some instructors use the blackboard to better effect than others; some get better results by asking the students questions. The material presented to the students and the method of handling a class vary from one instructor to another. Many of these variations, good in themsleves, are simply the instructor's way of adapting his own effective techniques to the training situation. However, regardless of the method employed, the goal of the instruction remains constant.

Instructors get sick, go on leave, or are transferred, and substitutes are brought in. Despite the fact that instructors change, it is unlikely that objectives should change. Yet, unless the course objectives are communicated to the new instructor, there is a chance that, without its being apparent, the true objectives may become twisted or some part of the instructional program may move out of line with some other part.

You, as training managers, should not forget that these same objectives should also be communicated clearly to training supervisors. Supervisors should know exactly what their courses are intended to accomplish, as they have the responsibility for determining requirements for equipment, time, and resources. The clearer the picture they have of the goal of a course, the easier it will be for training supervisors to get the support they need. In addition, they frequently have to represent, at conferences, a given course in relationship with other courses to which students will go or from which they will come. In both instances, there is a need for a clear statement of training objectives.

Finally, for supervisors to effect quality control of the training output, there is a clear *requirement for unambiguous, definitive statements of training objectives or of student performance objectives.* But what is a *Training Objective*?

A training objective is a precise clear statement of one of the performances expected of a student upon completion of a course. A complete list of such objectives constitutes the mission of a course.

Student performance objectives represent a clear statement of instructional intent, and are written in any form necessary to clarify that intent. The statements should also communicate the following:

(1) A training objective talks about the trainee—not about the course, the methods, or the instructor.

(2) A training objective describes the desired performance, behavior, or activities of the trainee at the end of the training.

(3) A training objective is concerned with *ends* rather than means, and describes a *product* rather than a process.

(4) A training objective must also describe the conditions, that is, the environment, the tools, and the specific arrangement or situation in which the trainee will be performing his terminal behavior.

(5) A training objective must also include information about the level of performance, the standard, the time element, or the behavior criteria that will be considered acceptable or indicative of a satisfactory trainee performance.

The development of job-related, detailed statements of objectives is a matter of the first importance and the highest priority in designing effective training programs. These objectives permit every element of a training program—lessons, texts, practical exercises, and examinations—to fall into line in a consistent manner. Training objectives that are job-relevant provide for a course that will be responsive to the needs of the job to which the trainee will go after the training, and that will include little irrelevant or unnecessary content.

It has been said that the purpose of knowledge is action. This is especially true in the world of practical affairs. From experience we know that knowledge doesn't do the

job, that the specific actions of men do. To a doctor, having a concept of the course of a disease is not the same thing as being able to treat and cure an individual with cancer, schizophrenia, or TB. Performance capability, then, should be the object of training and, in the world we're concerned with, training objectives should be based upon that capability and define it.

Moreover, it is the performance required by the man at his job that is the basic source of training objectives. The key question is, "What must this man be able to do in order to do his job well?" It is highly important that the man be taught only the things he needs for doing his job; teaching him things that are irrelevant to the job or teaching the wrong things can be very costly.

If a course teaches the man less information and fewer skills than he needs, the following difficulties may occur:

(1) The man will need further training on the job. Frequently, an industrial or medical team's capability to perform its mission will be limited because of a shortage of skilled personnel and the necessity for conducting on-the-job training.

(2) A poorly trained man—especially working in shops and laboratories around machines and equipment—may have accidents that might damage equipment or cause injury to himself or his fellow-workers. In an operating room, lives could be lost.

(3) The reputation of a school, hospital, training center, or an individual may be adversely affected if graduates of training courses cannot perform adequately.

On the other hand, teaching too much or teaching material that is not closely related to the requirements of the job may also be excessively expensive. Their costs are more subtle and harder to identify because they do not generate as many complaints from the field managers, but among these are:

(1) Longer courses than needed, requiring more student time and more instructors and facilities than should be necessary.

(2) Valuable time lost from productive job performance by individuals who are needed on the job, but who are still tied up in the classroom.

(3) Requirements for texts, training aids and devices, and equipment for the irrelevant material.

(4) Fewer graduates because students who could successfully learn the essential elements of the job may fail the irrelevant material and thus be disqualified for a job they would actually be able to perform.

(5) A narrowing of the manpower supply because of course prerequisites and classification procedures based on the irrelevant material. Some students who could learn the job will not get a chance to do so.

Therefore, as we have emphasized: The training objective should be based upon job performance requirements and there are three separate elements which form the structure of the objective: the *task* or behavior which the student must be capable of performing, the *standard* of performance he must reach, and the *conditions* under which he is expected to perform. Each element expresses a factor essential to the understanding of performance. By describing each factor of a performance requirement in sufficient detail, we create an explicit and measurable training objective. Usually the three elements of the objective are written in the following sequence: conditions, behavior or task, and standards. Consider the following example:

> Given only his watch and placed during sunlight in unfamiliar terrain, the student locates north within a maximum allowable error of seven degrees east or west.

This example contains the three essential elements to be reflected in the objective. What behavior or *task* must the student perform? He must locate north. What are the *conditions* for the performance? He needs a watch, the sun, and terrain in which he is

not oriented directionally. What are the performance *standards* he must achieve? He must not be off by more than seven degrees east or west.

Now, let's describe these three essential elements a little more fully.

First, *conditions*. As just said, usually the conditions are stated first. Conditions usually include essential features of the environment and equipment and assistance which may be given or denied the student. Conditions may also include references, facilities, situations, obstacles, and problems.

Second, *behavior or task*. The task is the heart of the objective—what the student will learn to do. Let's have a look at some task element statements.

Conditions	Behavior or Task	Standards
Given a 1:25,000 map and field compass, and placed at a location oriented with the map . . .	. . . the student proceeds by compass to 2 succeeding locations, each at least 700 meters apart . . .	. . . arriving at locations with an error of not more than 20 meters left or right.
Given an airdrop load-extraction linkage assembly unprepared for action by reason of unconnected deployment line and extraction-line extension . . .	. . . the student prepares the load-extraction linkage assembly for airdrop . . .	. . . within 5 minutes.
Given a Meter Test Set TS-682/GSM-1, necessary handtools, and a d.c. meter with two of the defects reflected below . . .	. . . the student repairs the meter and measures its current sensitivity . . .	. . . with an accuracy of not less than 97 per cent.
Given specific malfunction characteristics of a non-operating M-14 rifle . . .	. . . the student diagnoses at which of eight steps in the cycle of operations stoppage has occurred and the part-failure responsible for the break in cycle . . .	. . . Four out of five student malfunction diagnoses must be correct.

Third, **standards.** Standards refer to the degree of precision we wish the student to attain. They refer also to the measure of his acceptable performance. Standards of performance are stated in terms of speed and accuracy. Time standards may be expressed as a time limit for one performance or as a production requirement during a given time period. Accuracy standards are reflected either by the degree of perfection required in every act or by the percentage of times an act must be performed correctly.

Format for complex objectives. The standard order of conditions, task, standards will be used in complex objectives. Often, however, complex objectives will be stated in several sentences. This will dictate a wider variety of introductory terms than those desirable in simple objectives.

How adequate objectives are developed and evaluated. There are six major steps in the process of developing clearly defined job-relevant objectives:

First, a specialized form of *system analysis* is conducted to provide a context for the study of a particular job or military occupational specialty (MOS). As part of the system analysis, a mission profile or flow chart is prepared to provide a basis for developing the task inventory.

Then, a *task inventory* (an outline of the major duties in the job and the more specific job tasks associated with each duty) is prepared, using appropriate methods of job analysis.

Next, decisions must be made regarding *tasks to be taught and the level of proficiency* the students should attain, as it is not economical to teach every task in formal training.

In the fourth step, a *detailed task description* is prepared for those tasks to be taught, breaking each task into specific acts required for its performance.

After this, the detailed task description is reviewed to identify the knowledge and skill components involved in task performance. These components, in outline form, are then synthesized into a hierarchical organization.

Finally, each *specific objective* is reviewed and revised to make certain that it describes (a) the performance expected of the student, (b) the conditions under which the performance will be observed or measured, and (c) a standard of accuracy or speed to be achieved.[1]

Let us look a little more closely at the evaluation of these objectives.

In describing the objective's task, we must use specific words. Phrases such as "to know," "to understand," "to appreciate," "to realize the importance of," "to become aware of," and "to have a working knowledge of" should *not* be used because they require interpretation by the reader. What you mean by "to know" or "to appreciate" is not what someone else might understand it to mean. Therefore, since students, instructors, supervisors, and inspectors all must get the same meaning from the description of a task, the wording must be precise. No word should be used that requires a reader to decide for himself what is meant. Here are some examples of tasks containing precise words:

> Computes the subsistence requirements for a given size hospital for a given time period.
>
> Rejects all defective bearings from a mixed sample of ball bearings.

Measurable standards. Our objectives must have standards which can be measured. We have all seen standards expressed by such words as "working knowledge," "qualified," "effective," "acceptable," "proper," or "average"—words which are not exact enough for accurate measurement. What is "acceptable" to one person might not be acceptable to another. The result of using such terms is that we are not apt to have an understanding on standards among instructor, student, and supervisor. Here are two examples of standards which *can* be measured accurately:

> Allowing for no more than 5% error
>
> To a tolerance of plus or minus .1 ohm

Terms of achievement. Objectives must be stated in terms of what the student must do or achieve. Two correctly termed examples follow:

> The student differentiates between items by marking group items in red and individual items in black.
>
> The student adjusts head bolts until they are flush with the surface and no white space can be seen.

Precise meaning. Objectives should be examined word by word and phrase by phrase. If an objective contains a word or phrase which might require guesswork for its meaning, the ambiguous term should be replaced by a more exact one. Objectives must be specific; they must mean the same thing to any reader.

Now that we have gone to the trouble of preparing and evaluating our objectives, of what use are they? Are they worth the time and effort invested in getting them? How are they used in practical situations?

[1] Additional details may be found in: Robert G. Smith, Jr., *The Development of Training Objectives*, HumRRO Research Bulletin 11, June 1964.

First, let us remember that objectives describe the *performance* expected of the student at the end of the course. The student's performance at the end of the training period should be close to the performance required of the man on his job.

A training program is composed of many parts. In addition to presentations by instructors, there may be special textbooks or training manuals or programs used to present material to the student. This preliminary instruction is usually followed by supervised practice of the task to be learned. Training aids and devices are frequently used in practice and in preparation for practice. The knowledge acquired by the student is measured by various kinds of written tests and performance tests. Clear and communicable objectives are necessary in order to make sure that all these activities are contributing to the same goal.

Most people would agree that it would be unfair if an instructor taught one thing, had the student practice something else, and then tested him on something entirely different from either. Yet this kind of inconsistency does occur. For example, an instructor might describe how to perform a task, yet because of lack of time or equipment, or because of fear of damaging the equipment, the student might not be permitted to practice the entire task under expert supervision. It is not unexpected for the student to perform badly on a proficiency test calling for him to perform the whole task, when he has practiced only part of it.

Student performance objectives change this picture. By deriving objectives from the tasks the student will perform on the job, we establish a specific course outcome with which we can make realistic judgments. We enhance precision further by defining the conditions under which tasks will be performed and by specifying standards of acceptable performance. We can assure ourselves that what we decide to cover in instruction, the student will use later and that fascinating but unnecessary, nice-to-know information does not creep into our presentations. Upon such a solid foundation, we can feel confident of making sound training decisions.

Performance objectives are also of considerable value to the student. By giving him a list of specific objectives, we tell him precisely what is expected. He is not left to guess what is important. Knowing what he must be able to do and what he will be tested on, he is able to measure his achievement and concentrate his study effort where it is needed most. The student has a constant check on his progress. Invariably, experience shows that such clear-cut objectives motivate the student to achieve better work. He will apply himself more diligently when he has confidence that what he is learning in school will be required in the field.

In addition to providing a basis for decision-making, student performance objectives offer a number of advantages to the school, course, or the training program:

(1) They standardize instruction. Until the field job requirements change or errors in the original specifications are discovered, each class is trained by the same performance criteria. Although instructors come and go, there is a constant set of objectives against which instruction is to be prepared. All graduates must attain the same performance abilities. Thus, with clearly stated SPOs there is a greater likelihood that all graduates will attain the standard level of performance required by the job.

(2) They give us a basis for preparing a valid test of a student's ability to perform on the job. The primary purpose of an examination is to learn whether or not a student can do what he is being trained to do. Since student performance objectives are derived directly from job tasks, it is obvious that valid examinations based on performance objectives will measure a student's ability to perform.

(3) They should result in a better student-instructor relationship. The student will not feel he is at war with the instructor. Neither will he feel tricked nor feel that he must guess at what is expected of him.

Principles of Learning and Their Application to Training Program Development

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Introduction

Learning is one of the oldest and most thoroughly investigated topics in psychology. Literally thousands of research studies concerned with one or another aspect of learning have been carried out in the last hundred years. A sizable portion of this research has been aimed at identifying the conditions that affect the rate of learning and the degree of retention. The principles of learning which I will discuss are simply summary statements which indicate the relationship between various factors or conditions on the one hand and rate of learning on the other.

As you might expect, a good many principles of learning have been established, and I will try to cover some of the more important of these. It should be emphasized at the outset, however, that these principles cannot serve as explicit guides in the development of a training program. They *can* serve as a sort of policy guidance to help orient your thinking and to help you avoid serious errors in planning a training program.

As you know, in almost any field of knowledge a huge gap often exists between theory and application; that is, between abstract, general principles and the utilization of these principles in the practical, real-world situation. This is certainly true in the psychology of learning. The principles of learning which I will discuss are based, primarily, upon laboratory studies of the learning process under conditions which were deliberately highly controlled and artificial so that interpretation of the results could be most straightforward. In almost any kind of laboratory research in any field of knowledge, the experimenter attempts to hold constant all factors which could conceivably affect the results of his experiment, except the one factor in which he is interested—the so-called independent variable. In contrast, the training manager who has the responsibility of training men to do a job always attempts to make his entire program as effective as possible. He will utilize any and all principles that come to mind which might reasonably be expected to benefit the program. Hence, if a newly developed training program appears to produce more proficient graduates than its predecessor, it is seldom possible to identify precisely the factors in the new program which were responsible for its greater effectiveness. This statement is also true of most of the HumRRO research studies in which improved training programs were developed.

In discussing each of the principles of learning, I will first state the principle in general, everyday language. I will then briefly describe one or two research studies upon which the principle was based and, wherever possible, I will also describe a study or two in which that principle has been applied in a military training situation and has been shown to be effective. Finally, I will try to make suggestions about how this principle might be utilized in training program development.

Distribution of Practice

Distributed practice is generally superior to massed practice. This principle states that a given amount of training time or study time will generally produce faster learning

and superior retention if it is divided into a number of separate trials or training sessions rather than being concentrated in one block of time. "Cramming" for a course is much less effective than studying as you go along. Still another phrasing of this principle is: "Rest intervals facilitate learning."

This is probably the oldest and the best established of the principles of efficient learning. It has been found to hold in a wide variety of learning situations including school learning, the learning of mazes by both humans and animals, and particularly the acquisition of motor skills.

Memorizing Poetry. One of the classical experimental studies of the value of distributed practice was carried out by Bumstead (1). Serving as his own subject, he memorized various quantities of poetry under various study schedules. He must have been extremely fond of Milton's "Paradise Lost" because by the time he had finished his study he had memorized literally thousands of lines from this famous poem. His general procedure consisted of selecting various passages from this poem which were of equal length and presumably of more or less equal difficulty. Each passage would then be memorized by a different study schedule. In the *massed* condition, he read the passage over and over at one sitting until it was mastered. In the *distributed* learning condition, he inserted a rest interval between successive readings. The rest intervals varied between one hour and eight days. His principal measure of learning efficiency was: the number of readings required before he was able to recite the entire selection without error and without prompting.

A large mass of data emerged from this study, but I will report to you only certain sample findings which dramatically illustrate the point that distributed practice is more effective than massed practice. Table 1 indicates the number of readings required by Bumstead to memorize 50 lines of poetry under different conditions of practice. Note that under the massed condition, 49 readings were required to memorize the passage. When he used a one-hour rest interval between successive readings, only 43 readings were required. When a two-hour rest interval was used, only 34 readings were required, and so forth. As you look across the table you can readily see that the number of readings required to learn a standard amount of poetry decreased steadily with increasing size of rest interval. With an eight-day rest interval between successive readings, a total of only 14 readings was required.

Table 1

Number of Readings, Study Time, and Elapsed Time Required for Memorizing 50 Lines of Paradise Lost[a]

Measure	Interval Between Readings								
	0	1 hr.	2 hrs.	4 hrs.	8 hrs.	1 day	2 days	4 days	8 days
Number of readings	49	43	34	28	24	19	16	15	14
Study time (min.)	170	140	115	95	75	60	48	50	46
Elapsed time (days)	1	4	6	7	8	19	32	60	98

[a]From Bumstead (1)

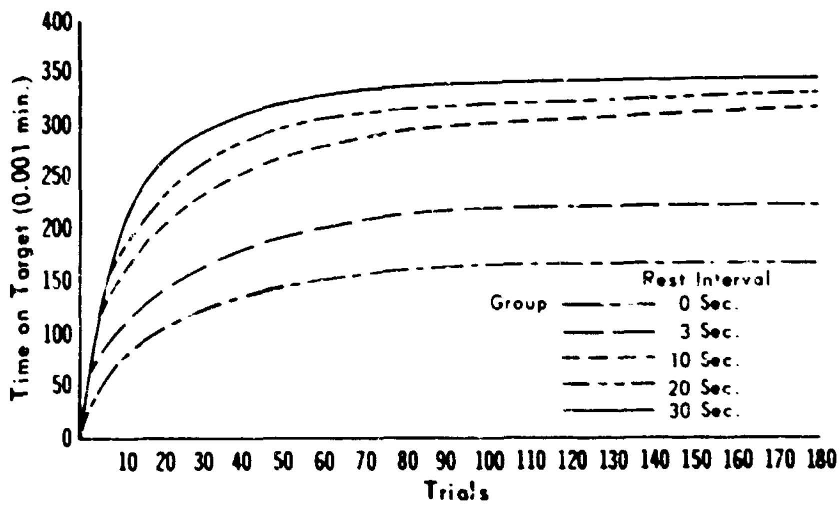
The second row of numbers in the table indicates the actual minutes of study time required to memorize the material under the various practice conditions. Under the extreme spacing conditions—that is, with an eight-day interval between readings—the total amount of study time was 46 minutes. Under massed conditions the total amount of study time was 170 minutes. It is apparent that the greater the interval between study

periods, the smaller the amount of actual study time required. However, if we look at the third row, which indicates the amount of calendar time that elapsed between the start of learning and the completion of it, we see that the greater the size of the rest interval, the greater the amount of elapsed calendar time. When Bumstead used an eight-day rest interval between readings, it took him only 14 readings to master the material, but a total of elapsed time amounting to 98 days, or a bit more than three months. Obviously, in many practical situations it is not feasible to spend three months learning a relatively small amount of material. However, if circumstances permit one to plan ahead and budget time wisely, distributed practice will require less actual study time and will also give a much better mastery of the material from the standpoint of improving retention. That is, material learned by distributed practice is retained much better and is forgotten less rapidly than material learned by massed practice.

Motor Skills. The superiority of distributed practice over massed practice is even more apparent in the acquisition of motor skills. One device which is commonly used in psychological studies of the acquisition of motor skills, is called the pursuit rotor. This device consists essentially of a rotating disc resembling a phonograph disc with a round spot affixed to the surface of the disc somewhere near its outer edges. The subject is to keep a metal stylus in contact with the spot on the disc as it rotates. This requires precise coordination, of course, and it takes time to become proficient at this activity. This is essentially a tracking task which, as you might readily see, has at least some formal similarity to the tracking activity connected with aiming a weapon at a moving target.

In one study of pursuit rotor learning (Adams, 2) five groups of subjects were employed, all of whom received 150 practice periods, each of 30 seconds duration. Thus, all subjects spent exactly the same amount of time practicing. However, one group had a zero interval between trials (in other words, they practiced continuously until they had spent an amount of time equal to 150 30-second sessions), while the other four groups had rest intervals between trials of either 3 seconds, 10 seconds, 20 seconds, or 30 seconds. Figure 1 shows the results of the study. Trials are represented on the horizontal axis and time-on-target is represented on the vertical axis. Obviously, the higher the curve, the better the performance. It is readily apparent that the greater the rest interval

Pursuit Rotor Performance and Distribution of Practice



NOTE: After Adams 2

Figure 1

between trials, the faster the rate of learning and the higher the ultimate level of proficiency attained.

In various other studies, it has been found that the length of the study (or practice) period, is a more significant factor in affecting these results than is the length of the inter-trial interval. In other words, if the rest interval between trials is held constant, but the length of the study period is varied, it is found that the shorter the study period, the faster the rate of learning.

Aerial Gunnery. There is one study which was carried out in a military setting (Crawford, 3). In a study of aerial gunnery training, distributed practice was found to be superior to massed practice. The results of this study are shown in Table 2. All pilots participating in this study were given 2,000 rounds to fire but the number of missions they were given in which to fire these rounds varied between four and eight. Notice that a group which was given eight missions in which to fire their 2,000 rounds fired fewer rounds per mission and hence constituted a distributed practice group. As you can see, the percentage of hits on the last mission was directly proportional to the amount of spacing or distribution involved in the training program.

Table 2

Relation Between Distribution of Practice and Final Proficiency in Aerial Gunnery for 221 Fighter Pilots [a]

Number of Missions Taken to Shoot 2,000 Rounds	Number of Pilots	% of Hits on Target on Last Mission
8	28	5.3
7	31	3.8
6	85	3.0
5	59	1.9
4	18	1.0

[a] From Crawford (3)

Suggestions. Although the topic *distribution of practice* has been extensively and intensively investigated for many years, it is difficult to generalize from the studies that have been made and thereby arrive at an optimum practice schedule. I will give you a few general suggestions, however, which may help you to avoid serious errors in scheduling training or practice sessions. These suggestions were developed by Dr. Robert Smith of HumRRO after he had carried out a review of the literature, and they pertain only to the training of motor skills:

(1) When trials are short—on the order of a few minutes or less—then a rest period of 30 to 45 seconds should be allowed between trials, with a 10-minute break after every 10 trials. If trials are longer, then a rest period of 35 to 45 seconds should be allowed between trials, followed by a 10-minute break after every few trials.

(2) If the student is given little or no rest, his performance level will be lowered. On the other hand, if rest periods are excessively long, time will be wasted.

(3) If the task makes excessive demands on the students' physical strength and endurance, then longer rest periods must be provided.

(4) The administrative constraints of the situation must always be considered. If the activity in which training is to be given requires a lot of "set-up" or preparation time, practice periods should probably be longer. For example, if a good deal of the time available for marksmanship training must be spent in transporting men to the training site

or in issuing special equipment, and so forth, it would not be practicable to have a great many short training periods. Too much time would be wasted in activities which do not actually advance the training. Compromises often must be made between the ideal distribution of practice and administrative constraints.

Knowledge of Results

Another well-established principle of efficient learning is referred to as "Knowledge of Results." A somewhat fuller statement is as follows: In any learning situation, a student generally learns faster if each of his attempts to demonstrate what he has learned is followed quickly by information concerning the adequacy of his response. In other words, a student must be more or less continuously informed about his progress if he is to progress.

The Line-Drawing Experiment. Probably the first experimental study of this principle was carried out by an eminent psychologist named Thorndike (4). The task he assigned his subjects was that of drawing a straight line exactly three inches long while blindfolded. With one group of subjects he informed them after each attempt as to whether their line was within acceptable limits; that is, he provided knowledge of results. As you would expect, this group rapidly improved their skill and began to consistently draw lines approximately three inches long. The other group, the experimental group, was given no knowledge of results. They simply practiced drawing one line after another. Not surprisingly, they failed to show any improvement and, in fact, soon became extremely bored with the whole activity. Thorndike summarized his findings by stating that the old adage, "practice makes perfect" does not always hold. Practice makes perfect only when each effort is followed by immediate information or feedback concerning the adequacy of the effort.

A more recent experiment by Greenspoon and Foreman (5), demonstrates clearly the fact that the more quickly a student receives knowledge of results, the faster he learns. Here, too, the subjects were required to draw a three-inch line while blindfolded. One group of subjects were informed immediately after they had completed their line, whether it was too long, too short, or about right. Another group was given this information after a 10-second delay; another, after a 20-second delay; and another, after a 30-second delay. The results obtained in this study are shown in Table 3. Notice that the group which received immediate knowledge of results (zero delay) made the highest score, and that the longer the delay the poorer the score.

Table 3

Effect of Delaying Knowledge of Results[a]

	Delay (seconds)			
	0	10	20	30
Mean number "right"	27.4	21.9	15.0	14.0

[a]After Greenspoon and Foreman, (5)

Other Kinds of Learning Tasks. Knowledge of results is a powerful influence upon learning and performance rate for almost any task that one can think of, not only in the acquisition of motor skills, but in the acquisition of knowledge as well. Several studies (e.g., Angell, 6) have found that college students who are given immediate knowledge of their quiz performance show greater improvement on subsequent quizzes than do students who receive delayed information concerning their quiz performance.

An old study by Pressey, the forerunner of programed instruction, used a special kind of printed booklet designed in such a way that when the student marked a particular alternative for his answer, he would immediately see whether his answer was right or not, due to chemical changes in the color of the paper. When such students were allowed to re-take a quiz immediately, their performance was much improved by the knowledge of results in the original administration.

Natural Versus Artificial Knowledge of Results. Knowledge of results may be either "natural" or "artificial." When a bowler releases his ball he can watch it roll down the alley and immediately see how many pins he knocks down. This is a situation in which natural knowledge of results is provided. When a soldier goes through the TRAINFIRE course and shoots at pop-up targets, the fact that the targets fall when hit provides natural knowledge of results. Such natural knowledge of results is quite effective in enhancing learning rate.

In many training situations, however, knowledge of results must be somewhat artificial. In aerial gunnery training, it is obviously not feasible to provide actual flying targets for the gunner to shoot at except perhaps on rare occasions. In general, the gunner must be taught to recognize the correct sighting picture as he aims the weapon. In a well-known study by Bilodeau, *et al.* (1), artificial knowledge of results was used in the attempt to enhance the learning of aerial gunnery. The students' task in this situation was to keep the gun aimed at the moving aerial target as guided by the sight of the target in the gun sights. Ordinarily, the only knowledge of results which the student obtains is that provided by the sighting picture.

In the experiment now under consideration, the experimenter arranged the device so that a buzzer would be sounded continuously whenever the student was properly on target. In other words, the buzzer provided additional (but artificial) knowledge of results. The results were that students' performance did improve appreciably when the buzzer was provided. However, in subsequent stages of the experiment, when the buzzer was withdrawn, the performance fell back to the level that had generally prevailed before the buzzer was introduced. In other words, it appeared that the artificial knowledge of results inherent in the buzzer served only to prop up a student's performance, but did not teach him the kind of skill which was necessary for the ultimate job.

In general, it has been found that artificial knowledge of results is relatively ineffective in teaching any continuous type of motor skill; that is, in teaching a motor skill where continuous feedback is essential for effective performance. With regard to skills that consist of discrete acts, such as rifle firing, artificial knowledge of results may be quite effective. If a rifleman shooting at a bullseye is verbally informed after each shot as to whether he hit the target, or by how much he missed it, and so forth, this is an example of artificial knowledge of results which can be quite effective because the skill consists of discrete acts. For best results, such verbal feedback should be provided as quickly as possible. If the delay is too great, the student will be unable to remember the precise pattern of coordination he had used in firing that particular round.

Suggestions for Employing the Principle of Knowledge of Results. At this point I will try to distill, from the information presented, a few practical suggestions as to how the principle of knowledge of results might be utilized in building a training program. These suggestions are rather broad and general, and can by no means serve as a cookbook for program development. In many practical situations their use may be precluded by the unique characteristics of the task or knowledge being taught and administrative constraints. These suggestions should, however, help to avoid egregious mistakes in program development:

(1) In any training program, whether its purpose is to instill knowledge or to develop a motor skill, it is essential that students be informed from time to time concerning the adequacy of their progress. In the teaching of knowledge, students must

be called upon to demonstrate their mastery of the material, ideally by applying it in practical work situations, or if that is not feasible, by taking a written examination. They might then be given confirmation of the correctness of their knowledge either by simply informing them of their test score or by letting them experience the achievement involved in the successful application of that knowledge in a practical exercise.

(2) Knowledge of results should be provided to students as soon as possible after each performance. It is recognized that administrative considerations often preclude providing knowledge of results after each individual response. However, this ideal should be kept in mind and approached as closely as is feasible. In most instances, it probably is possible to grade examination papers quickly and return them to the students promptly. If knowledge of results is delayed too long, it will be relatively less effective—probably because students have forgotten many of the original responses in the interim.

(3) Insofar as possible, students should be informed as to the exact nature of their mistakes, and the proper responses should be pointed out to them. Such a procedure is much superior to that of simply informing them whether they are right or wrong. More detailed explanations of the nature and extent of errors provides the student with information he can use to correct his errors on subsequent attempts.

(4) When the learning task does not provide *natural* knowledge of results and it is, therefore, necessary to use *artificial* knowledge of results, be alert to the possibility that the artificial knowledge of results may simply prop up the performance and, in effect, teach the student the wrong skill. Test trials should be inserted from time to time in which the artificial knowledge of results is withheld, in order to minimize the likelihood that the performance will deteriorate when the student practices in the on-job situation.

The Effect of an Active Versus a Passive Attitude

Here we are concerned with the general orientation of students toward a learning task. This principle might fit more properly under a general heading of study techniques rather than as a principle which can be manipulated by a training manager. However, sometimes there are certain limited actions which the teacher or training manager can take which will encourage the development of an active attitude on the part of the students, and hence facilitate learning and retention.

Intention to Learn. There have been many laboratory studies in which intentional learning was compared with incidental learning. It is true that people occasionally learn things which they have made no effort to learn, but the efficiency of such incidental learning is far inferior to that of intentional learning. Many years ago a psychologist by the name of Sanford (Dockeray and Lane, 8) reported that for many years he had been reading a certain Episcopal prayer each morning, so that he had read it more than 9,000 times over a 25-year period. Nevertheless, when he tried to recite it without the use of the text, he was unable to do so.

In a more recent study (Neimark and Saltzman, 9) certain students were asked to simply read lists of nonsense syllables for certain other students to memorize. In other words, these students were acting as experimenters. After each student had mastered the list, the other student who had been reading the list for him was asked to recite it. True, they had learned some of the words, but they had by no means mastered them. Apparently, the lack of intention to learn encouraged a passive sort of attitude with the result that very little was learned.

You have probably had the experience of reading some textbook assignment in a half-attentive way, with your mind on other things. Generally, after such a reading, you find that you remember very little of what you have studied. This brings us to the next minor topic under the general heading of the effect of an active attitude.

The Effect of Recitation. It is highly advantageous in studying any kind of material to recite it to yourself periodically.

In a classic study by Gates (10), subjects were required to study some biographical material and eventually be tested for their mastery of it. Different groups of subjects were given different sorts of directions, however. Some were told to put 100% of their time into reading the material. Other groups were told to spend various proportions of their total study time in reciting to themselves what they had learned. One group spent 20% of their time reciting. Another group spent 40% of their time reciting; another group 60%; another group 80%. Scores on the final achievement tests showed that the more time spent in reciting to one's self, the higher the achievement. The group which spent 80% of its study time reciting got far better scores than did the other groups.

A practical implication of this principle is that students should frequently be required to demonstrate what they have learned. It is probably wise to terminate each lecture period with some sort of quick review or recitation required by the students. In practice this is seldom done.

Apparently, recitation and review shortly after learning serves to consolidate what has been learned and retards the forgetting process. Material which has been learned in this fashion with frequent recitations is far more resistant to forgetting than is material learned by other more conventional methods. It might be mentioned here that programmed learning regularly requires students to take an active role. They must make some kind of response to almost every item of information presented to them. It has been found that when students are required to respond frequently, they develop a more active attitude and master the material more quickly.

Sleep-Learning. Perhaps the topic of sleep-learning should be briefly mentioned. You have probably seen articles in newspapers or other mass media which claim that a tremendous amount of learning can take place while one sleeps. There are said to exist commercial sleep-learning companies which claim to be able to teach people to speak a foreign language while they sleep. Order the records, put them on each night and, presto, in a few weeks you will have mastered the language! Actually, experimental studies of sleep-learning indicate that very little can be learned while an individual is really asleep. This is about as passive an attitude as one can have, obviously. Some early experimental studies apparently showed that sleep-learning occurred. But more recent, better controlled studies, which used the electro-encephalograph for ascertaining that the student was actually asleep when the learning material was presented, found that almost no learning occurred—certainly not enough to justify putting out the expense and effort to obtain the equipment. There is no substitute for active, intentional learning.

Meaningfulness of Material

Another well-established principle of learning states that meaningfulness facilitates learning. Another version of this principle might be "the more meaningful the task or the information which you are attempting to learn, the more easily you will be able to learn it." This is, of course, quite consistent with common sense and surprises no one. If you were asked to memorize a list of 10 or 12 nonsense syllables such as: fid, dub, teg, and so forth, you would probably find it rather difficult to do. If you were asked to memorize a list of isolated English words which had no particular sequence or organization to them, you would find this a good deal easier to do, since the words would be more meaningful than the nonsense syllables. If you were asked to memorize a list of words which actually fitted together in a logical fashion to form a complete sentence or a complete thought, you would probably be able to memorize a quite lengthy "list" after one hearing.

The effect of meaningfulness of material upon ease of learning has been investigated intensively for many years. Much of this research effort has been directed at the attempt to explain why or how meaningfulness facilitates learning. Such theoretical matters are of no great relevance to the purpose of this particular course, but it might nevertheless be worthwhile to mention one factor which illustrates this relationship. In attempting to manipulate the variable of meaningfulness in psychological research, a common procedure is to utilize stimuli, that is, nonsense syllables, words, or whatever, which vary in their association value—that is, which have varying numbers of associations to them. If you were asked to say what the nonsense syllable "fid" reminds you of, you would probably think of a great many associations. It has been found that the number of words which you can associate to a stimulus is directly related to the ease with which that stimulus item can be memorized.

One implication of this principle for improving one's own study habits is that you should try to think over and digest any new facts or information which you read. If you can relate a new piece of information to other pieces of information already in your repertoire of knowledge, you will probably find it much easier to recall the newly learned item when the occasion arises for you to do so. William James, the famous philosopher and psychologist, characterized such associations to newly learned facts as hooks. The more hooks you can create for a newly acquired piece of information, the more readily you will be able to dredge it up from your memory.

Suggestions for Employing the Principle of Meaningfulness. What are the implications of this principle for training program development? There are several, most of which are relatively minor with the exception of one which will be taken up in the following section.

(1) Try to avoid having students memorize lists of isolated facts. For example, avoid lengthy drill sessions on such relatively meaningless material as the nomenclature or location of equipment or its parts. Instead, integrate this kind of training with training on the function of each piece of equipment or its parts. If a student learns the name of a particular equipment part at the same time that he is taught how to use it, on what occasions he should use it, and what its effects are, he is much more likely to remember it. You will note that he has associated it with various other pieces of information which have some practical meaning to him in the light of the job for which he is being trained.

(2) If a situation arises where students must memorize lengthy lists of relatively meaningless material, it is often helpful to encourage them to impose some sort of extrinsic meaning or organization upon the stimuli. Reciting them rhythmically is one aid, and having them think up relatively far-fetched associations sometimes helps. The latter are not consistently reliable aids, however.

(3) The most important implication of this principle of meaningfulness pertains to the area of organizing and sequencing of instructional materials (see next section).

Functional Context Training

You have probably already encountered this term a few times, but perhaps in only an incidental way. In the next few pages, I will attempt to give you a fuller understanding.

Functional context training might be regarded as a pedagogic technique or as an educational philosophy, or perhaps both. The philosophy and the term came into existence some eight or nine years ago, and grew out of the joint thinking of certain HumRRO personnel and certain personnel at the U.S. Army Signal School, Fort Monmouth, New Jersey. At that time, HumRRO had a research task under way (Work Unit REPAIR) which was aimed at improving the effectiveness of Signal Corps electronics maintenance training. In this connection, an experimental radio repair course was built

through the collaborative efforts of HumRRO and Signal School personnel (11). In the many conferences that took place in planning that course, the idea of functional context training gradually emerged and came to be the principal basis on which the experimental radio repair course was organized (12).

What is functional context training? The central or basic notion of functional context training is that for training to be most effective, it must be presented in a context that is meaningful to the student. Instructional material which is clearly and explicitly related to something the student already knows can be more readily learned, better retained, and better applied, than instructional material which is not introduced in this meaningful fashion.

Perhaps this notion sounds quite reasonable to you, but I think that you will see that relatively few instructional courses, either inside or outside of the military, really succeed in making introductory material meaningful to beginning students. Most courses, both military and civilian, are constructed by individuals who know their subjects thoroughly and who organize their material in a logical fashion that is quite meaningful to them. But the logic and order which they see in their course organization often escapes the beginning student entirely. Let me describe some examples.

Biology Example. Unless things have changed greatly in recent years, the typical biology course in high school or college begins with such topics as the nature of protoplasm, cells, then protozoa, paramecia, then perhaps jellyfish, and so on up the phyletic scale. For the beginning student, protoplasm and cells are items far from his realm of experience. They mean very little to him and he will have trouble seeing how they will help him understand the functioning of the human or animal body. If the objective of a biology course is to give the student an understanding of how the body functions, it would be much more meaningful and appropriate to begin with a consideration of the total functioning organism and then consider each of the major organ systems of which it is composed. Instruction could gradually work down to the cellular level. Incidentally, it is worth noting that the scientific knowledge of the human body which now exists was acquired in the latter sequence; that is, from the whole to the part, or from the molar level down to the molecular level.

Electronic Maintenance Example. As another example, let us consider the traditional electronic maintenance course. Up until recently, at least, most electronics maintenance courses have been organized somewhat in the fashion of the hypothetical biology course described above. In other words, the typical electronics course begins by teaching the students something about the structure of matter, including a consideration of molecules, atoms, electrons, and perhaps protons. All such entities, of course, are far from the realm of experience of the typical beginning student. It is perfectly true that a thorough understanding of electricity and electronics requires a knowledge of electron theory, but is this meaningful to the beginner? Of course, instructors typically inform the students that all material of this sort is very important and that it will be useful to the student later on in the course and later on in his job. The beginning student, however, cannot himself see the relevance of such material to the maintenance job which he is supposedly being trained for. He has to take it on faith. If the student has somewhat limited scholastic aptitude to begin with, he may find himself completely confused and unable to grasp abstract material of this sort.

A typical electronics maintenance course then proceeds in somewhat the following fashion: The basic elements of electricity are described—that is, voltage, resistance and current, simple series circuits, parallel circuits, and Ohm's Law. Gradually, more complicated kinds of circuits are described and explanations are given of how circuits can be combined into even larger units to perform various functions, and so forth. Finally, after the student has been in the course many weeks, he sees a working radio set and is told something about how it functions. Several weeks may have gone by

before this point is reached. Meanwhile, the student has had to attempt to grasp and retain a tremendous amount of rather abstract material unrelated to his general body of knowledge and experience.

In several studies of student attrition in electronics maintenance courses, it has been found that the flunk-out or wash-out rate is greatest during the early weeks of the course when the subject matter is primarily theoretical background material. This is understandable. Fundamentals of electronics is a pretty abstract, difficult subject for the student who has no previous experience which will serve as a meaningful context into which he can fit the new instructional material.

So far I have been describing and criticizing the traditional way of organizing electronics maintenance courses. Now I wish to talk about how such a course can be organized using the functional context principle. Remember that the central notion of functional context training is that all instructional material should be presented in a context which is meaningful to the student. What is the broadest, most inclusive, most meaningful context into which the entire subject matter of a maintenance course can be fitted? The answer is the job situation for which the student is being trained.

Ideally, everything in a course should contribute to the development of ultimate job proficiency. All students can be expected to know what a radio is and, at least in a general way, what a radio repairman does. It follows, then, that all instructional material included in a radio repair course should be explicitly related to the job of the repairman. Instead of giving the student a sound background in theory, why not let the primary objective of the course be to make the man the best repairman possible? Theory would then be presented only to the extent that it clearly contributes to the development of maintenance proficiency.

In the experimental radio repair course developed jointly by HumRRO and the Signal School, the very first lesson in the course introduced the students to a complete communication system; that is, to a miniature transmitter and receiver. Students were taught how to operate these simple devices and to actually communicate with each other. It was explained that every communication system must contain certain elements:

(1) A source of energy.
(2) A means of adding voice or other information to that energy
(3) A means of getting that energy from one place to another.
(4) A means of recovering the voice or other information from the radio energy.

The components of the radio set which performed each of these functions were identified and explained in a simple, nontechnical fashion.

In the second hour of instruction, students were introduced to a very simple military radio communication system. They were taught to operate it and how to make a very simple repair—replacing a dead battery. Thus, on the first day of the course, the students acquired a rough understanding of the essential elements of a radio communication system; they had experience in operating such a system, and they engaged in some elementary troubleshooting—diagnosing the fact that the battery needed to be replaced. All of this was clearly relevant in the students' eyes to the job of the radio repairman.

Probably in any training course designed to produce a particular set of job skills it would be desirable to acquaint the student by first-hand observation, if possible, with what a trained and experienced man actually *does* in carrying out his duties in such an assignment. In organizing the instructional material for the HumRRO experimental radio repair course, care was taken to point out to the student the relevance of each block of instruction to the repairman's job for which he was being trained. Any material which could not be justified in this way was not included in the course design. Electronics theory was taught in relatively small doses at various points in the course, but only where the maintenance task under consideration required such knowledge. After each block of

theoretical instruction, the student was immediately required to carry out a practical exercise in which the theoretical material just learned was essential for carrying out the assigned exercise.

With respect to each item of equipment taught in the course, instruction always proceeded in a whole-to-part sequence which parallels the actual, on-the-job trouble-shooting sequence. In other words, the student first learned to operate the set so that he could discriminate between a properly operating set and one which was malfunctioning. Next, he was taught to sectionalize the troubles to major components within the system. Then he learned how to identify the defective stages, that is, the smaller subsections within these components, and so on. In the course as a whole, each successive item of information imparted was fitted into a context of things already learned.

The experimental radio repair course was evaluated by comparing the proficiency of graduates of this course with the proficiency of graduates from the standard course. Five performance-type tests were used as evaluation instruments. The experimental course graduates were significantly superior to the standard course graduates on most of the tests. This finding suggests that the functional context principle is indeed a valid one. However, it should be pointed out that the experimental course contained many features in addition to the functional context principle, which were not present in the standard course. You may recall that earlier in my presentation I mentioned the fact that experiments carried out in practical training situations seldom permit an unambiguous interpretation. However, it was the opinion of virtually everyone associated with this course that the functional context principle contributed importantly to the effectiveness of the course.

Another study of the functional context principle was carried out by HumRRO at the U.S. Army Southeastern Signal School at Fort Gordon, Georgia. There, only a portion of a radio repair course was revised along functional context principles with no other modifications put into the course. This arrangement permitted a more straightforward evaluation of the contribution of the functional context principle. The results of this study were rather interesting. It was found that low aptitude personnel trained under the functional context arrangement did appreciably better than the low aptitude personnel trained under conventional methods. With respect to high aptitude personnel, however, there was no significant difference between the proficiency of the functional context trained students and conventionally trained students. Apparently, low aptitude students tend to get lost and stay lost when abstract instructional material is presented to them in the conventional part-to-whole context. Apparently, high aptitude students are better able to grasp complex, technical and abstract material regardless of the presence or absence of a functional context for such material.

Implicit Acceptance of FCT. The term "functional context training" is not encountered as often today as it was a few years ago. I believe the reason for its obsolescence is the fact that the basic notions of this concept are now implicit in the general procedure you have been learning in this course about how to go about developing training programs: Analyzing the broad system in which the graduates of your course will function; analyzing the job of the course graduate in terms of the duties and tasks of which it is composed; defining the precise objectives of the course in behavioral terms; using all this information in a systematic way to organize course materials. All these steps clearly imply the need to tailor the training specifically to the job, to eliminate extraneous material from the course, and to make the course content clearly relevant to the actual job for which the man is being trained.

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Training Techniques

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Training techniques can be divided into two broad categories: (a) lecture method (or the lecture-conference method as it is generally called in the Army), and (b) a wide variety of student participation techniques.

The Lecture Method.

In the pure lecture method, information flows in only one direction—from the instructor to the students. The instructor talks, ideally from a well-planned outline, he gives examples, illustrations, and perhaps conducts demonstrations. The students' role in the lecture method of teaching is passive; they are not called upon to answer questions or to demonstrate their mastery of anything. Thus, in a pure lecture situation, most of the principles of learning, which are discussed in the preceding paper, do not appear to be present. It is reasonable to assume, however, that skilled instructors do succeed in stimulating interest and curiosity on the part of the students so that when information which satisfies those interests is subsequently provided, the students feel some satisfaction or reward for their attentiveness. It is also true, of course, that students may experience considerable reward when the examinations given from time to time inform them that they have indeed mastered the material which has been presented.

The lecture method, in some form, is probably the oldest and the most widely used procedure for transmitting factual information or knowledge from an instructor to his students. Nevertheless, many people have become disenchanted with the straight lecture method, probably on the basis of intuitive judgments that more involvement on the part of the students would produce higher levels of learning. Presumably it was from such thinking that the Army philosophy of using the "lecture-conference" method came into existence. The lecture-conference method is roughly equivalent to the more traditional educational term, "discussion method."

There have been numerous studies by educational psychologists of the relative merits of the lecture method and the discussion method, but the results of these studies are quite inconsistent. The inconsistency probably arises from the vagueness of the terms. Some teachers use the term "discussion method" to refer to any arrangement in which the lecturer permits the students to ask questions from time to time. Others use the term to refer to an arrangement in which the instructor adopts a laissez-faire role and encourages the students to structure the class activities. Thus, what one person calls a discussion method might be referred to as a lecture method by someone else.

In one study by Ward (1) it was found that lower ability students learned and retained better under the straight lecture method, whereas higher aptitude students learned and retained better under discussion procedures. We might conjecture that the less able students found it difficult to follow the discussions and were frequently in doubt as to which, of the various statements made by students, were correct and should be retained. When all information is presented by the instructor, lower aptitude students are presumably less subject to confusion.

Student Participation Techniques for Job Training.

As you know, there are a great variety of techniques that can be used to involve students directly and actively in the learning process. The best known of these are probably (a) practical exercises of one sort or another, and (b) use of training aids, devices, simulation, and so forth.

These two kinds of student participation techniques find their principal application in training programs designed to prepare students for carrying out certain job duties or tasks. In other words, these techniques are used to assist in the development of specific skills rather than for simply instilling knowledge. It is recognized, of course, that students must often be taught certain enabling knowledges before they can be expected to master the desired skills.

In certain other training programs the primary objective is not so much to develop skills as to modify attitudes and points of view of the students. Often in military training programs this is an incidental or secondary objective. For example, in equipment maintenance courses, instructors do make some effort to develop desirable attitudes in the students with respect to preventive maintenance, proper care of tools and equipment, and so forth.

The first set of student participation techniques which we will take up are the more familiar ones used in conventional military training programs.

Practical Exercises. Early in this century John Dewey, the American philosopher and educator, propounded the dictum "Learn by doing." Dewey's influence upon American education was great. He introduced and emphasized the notion that pure knowledge, which is never put to the test of use or application, is seldom thoroughly grasped and is unlikely to be retained very long. The true test of mastery of any subject matter is the ability to apply that knowledge in the practical situations of life. The learning process is not really complete until such applications have been carried out. I hope that I have not done an injustice to Dewey in this loose paraphrasing of his thoughts. At any rate, if knowledge is being imparted on the assumption that it will facilitate certain performances, it is clear that the ability to execute the desired performance is the true test of training effectiveness.

You may recall that the functional context philosophy of training, described in the preceding paper, contained a few suggestions about the use of practical exercises. Specifically the point was made that abstract, theoretical material or information should not be given to students until they were already confronting a situation, structured by the teacher, in which a particular maintenance problem cannot be solved without knowledge of that theoretical material. After the theoretical material is presented, the students immediately apply it in actually coping with the maintenance problems confronting them. This is an ideal which should be striven for in planning any training course, although it is often difficult to arrange. That is, one should strive for an optimum integration of practical exercise work and lecture or lecture-conference type of instruction.

Use of Training Devices. Whenever it is convenient to do so, of course, it is desirable to have students carry out their practical work on the actual equipment which they are being trained to work on. This sort of arrangement probably optimizes the conditions for transferring training to the target job situation. However, in many instances it is not feasible to have the students practice on actual equipment. If the actual equipment is expensive, in short supply, or highly susceptible to damage by inexperienced hands, then it is desirable to have students practice on some sort of training device or simulator.

You have probably seen some very elaborate, high fidelity, costly simulators in use at various Army training schools. Actually, complete simulation of the target equipment is seldom necessary. To be effective, a simulator must simulate the cues to which

men must respond on the actual equipment and must also afford an opportunity for the student to respond in a way comparable to the way he would respond on actual equipment. Furthermore, the simulator must include some provision for giving the trainee knowledge of results.

A study by Denenberg (2) compared the effectiveness of an elaborate tank-hull trainer which cost $10,000 with the effectiveness of an inexpensive mock-up built by HumRRO personnel at a cost of $27. Surprisingly, it was found that the inexpensive mock-up did a better job than the expensive simulator in training the men to start and stop the M-47 tank. The mock-up, the expensive simulator, and the actual tank were all found to be equally effective in teaching such things as nomenclature and location of instruments and controls.

Another HumRRO study (Cox, *et al.*, 3) found that training men to carry out a procedural task (performing a series of steps in a prescribed order) could be effectively accomplished through the use of photographs or drawings mounted on boards of about the same size as the actual equipment. Knowledge of results was provided by an instructor or an assistant, or sometimes another student.

Continuous motor tasks such as those involved in aiming weapons, that is, tracking behavior, do usually require fairly complex training equipment. Simulators for such tasks as these must provide displays and controls which influence the display. Aircraft simulators, driver trainers, and radar tracking simulators are all examples of continuous task trainers.

Student Participation Techniques Used in Management Training.

We will now take up several student participation techniques which have little or no relevance to the teaching of specific job skills, but which are used primarily in the training of executives, managers, and so forth. I am referring to such techniques as the case study method, role playing, and gaming. In each of these methods or techniques, the principal objective is not so much to teach specific knowledge, facts, or skills, but to modify the attitudes, the point of view, the general perspective which a high level manager brings to bear when facing relatively complex problem situations. In each of these methods, a great deal of discussion takes place between the trainees, one with another, and between the trainees and the leader or instructor. Typically, trainees in these situations become emotionally involved to varying degrees and emerge from such training sessions with a feeling that they have gained a greater insight into interpersonal relations, that is, how to get along with people, and have enhanced their general problem-solving ability.

The Case Study Method. The Case Study Method has been used for many years in the training of lawyers and physicians, but today the technique is probably most closely associated with the field of management training—especially as carried out at the Harvard Business School. The procedure is somewhat as follows: A small group of students or trainees is presented with a description of a complex real-life problem. The description is generally presented to them in printed form and is told from the perspective of one of the individuals involved in the problem situation. The description of the problem may be rather brief or it may be detailed. Sometimes the problem description is deliberately lacking in certain relevant information in order to give the trainees experience in recognizing a need for more information. Typically, the problem involves numerous aspects or factors, all of which must be taken into account in reaching any decision as to course of action to be recommended. A typical business problem might involve such matters as personalities of particular individuals, costs of raw materials and transportation, communication problems, scheduling difficulties, and pay rates.

The Case Study Method was devised primarily as an effort to bridge the gap between knowledge of facts and general principles, and the application of these to real-life problems. In a sense, the Case Study Method attempts to simulate the real-life situations so that the trainee can, in a compressed period of time, under expert guidance, accumulate some of the wisdom and understanding which otherwise could be gained only through many years of practical experience.

The essential goal of the Case Study Method is to develop in the student an effective style of problem solving together with gains in emotional maturity, objectivity, flexibility, and other personal attitudes. The trainee is asked to think out answers for himself rather than to simply absorb a "school solution" delivered by an instructor. In other words, the training objective here is not to impart specific knowledge but to develop in the student an ability to analyze problems realistically and to master the tangle of facts and circumstances that frequently suggest conflicting solutions.

In a well-conducted case study, the trainee learns that solutions are frequently not as obvious as they had first appeared, and that others do not perceive the same set of events in what seems to him to be the obvious way; he learns not to always look for a single, correct answer. Hopefully, he also becomes more flexible, that is, less inclined to cling to initial goals and procedures or to fixate on favored theories or generalizations. Instead of looking for a person or agency to blame for the problem situation, he learns to ask "What's going on here?" He learns to adopt an analytical, fact-finding orientation toward problems and to eventually arrive at a solution which he is willing to live with when there is no wholly satisfactory solution.

Certain other subsidiary gains or benefits are said to arise from participating in well-conducted case study training sessions. Students may increase their ability to communicate their thoughts to others and become better able to engage in cooperative techniques of problem solving. An experienced instructor can maximize the effect of the case method by confronting the trainees with their semi-conscious assumptions and attitudes which interfere with the effectiveness of their approach in handling a problem. For example, the instructor might point out to a particular trainee that he is implicitly assuming that indecision is a sign of weakness. This may or may not be true in any particular situation, but it is an example of an assumption which an individual is likely to make without realizing that he is making it. Another trainee might be advised by the instructor that he implicitly assumes that a frontal assault upon any problem is the most effective.

Sometimes individuals who are only superficially acquainted with the Case Study Method mistakenly believe that its purpose is to give students or trainees practice in applying general principles to specific problem situations. Actually, most advocates of the Case Study Method do not endorse this conception of it. Instead, they use the method to teach the concept that each problem is unique and that set principles or laws of human behavior often have very limited application. Their intent is to force the trainees to think in terms of particulars rather than abstract generalities. Their basic purpose is to teach students how to deal with certain types of problems rather than learn a set of solutions which have value in themselves.

The instructor has a difficult role to play. He must avoid playing the role of the expert who has all the right answers, despite the fact there will be considerable pressures on him from the trainees to fill this kind of expert role. He must encourage diverse opinions and independent thinking and at the same time try to get the trainees to become aware of the assumptions that are influencing their thinking. The instructor seldom offers information or opinions. Instead, he frequently classifies and summarizes ideas expressed by the trainees and raises questions to stimulate their thinking in new directions, and he points out assumptions which are implicit in their thinking. He tries to

play a role that is active enough to maximize the trainee's learning experience, but not so active that he inhibits independent thinking and questioning on the part of the students.

There is a variant of the Case Study Method with which you are all probably familiar. In this variant form the problem or case, which is presented for discussion, *does* have a definite right or correct solution and the instructor attempts to guide the students' thinking in discussing the problem until they finally see for themselves the correct solution. Exponents of the pure form of the Case Study Method feel that this variant is really not an effective or efficient use of the approach. They contend that if the problem does have a specific correct solution it would be more economical of time to simply present the students with a description of the problem along with the correct approved solution.

Role-Playing. Role-playing is another management training technique which has much in common with the Case Study Method. Its principal point of difference with the Case Study Method lies in the fact that role-playing requires the trainee to actually "act out" what he would do in a simulated problem-situation instead of merely talking about possible courses of action.

In the role-playing method the individual trainee is given a brief description of a problem situation and is told what role he is to play. The amount of detail with which his role is specified varies widely. But role-playing differs from dramatic acting in that a verbatim script is *not* provided. Also, realism and acting skills are not emphasized. There is usually a trainer, (i.e., the instructor) who gives the student an understanding of the purpose of the role-playing exercise and makes sure that the plot situation which he presents is relevant to the point he is trying to teach. The instructor or trainer also endeavors to establish an atmosphere in which the trainees will not feel self-conscious. He informs them that he will intervene from time to time either to interpret the trainee's action or to provide some general direction to him or to the other players. A role-playing session may involve any number of people, but typically one, two, or three are involved in any one scene. The scenes themselves may last for a few minutes or several hours, and are followed by discussion and analysis of feelings and thoughts of the participants.

Here is an example of a role-playing exercise involving two players. Each player is given a separate set of instructions or preparations for the role. Neither player knows exactly what instructions the other player has been given. Mr. Johnson is told to play the role of a supervisor in a business concern. He is instructed as follows: "One of your subordinates, Mr. Smith, has just come into your office. He is obviously in a bad mood and angry. You do not know why, but you do know that annual pay increases were announced this morning and that Mr. Smith's increase was quite small compared to what he had gotten in the previous five years. In your opinion Mr. Smith has reached the peak of his career in terms of responsibility and proficiency."

The other trainee is told to play the role of Mr. Smith. He receives the following instructions: "You are an employee of Mr. Johnson. You have just entered Mr. Johnson's office and you are quite angry. Mr. Johnson has failed to follow up on the procurement of an item which is vital to the continued productiveness of your department. In addition, as you were leaving your own office on your way to see him, you were advised of your latest salary increase which is considerably lower than what you had expected and what you had received in the last few years."

The actual dialogue that occurs in a role-playing situation such as this will obviously vary considerably from player to player. However, with the particular instructions which each has received it is likely that Mr. Johnson, the superior, will assume that Mr. Smith is angry about his small raise, whereas Mr. Smith, having received the instruction which he received, is probably more concerned about the delay in procurement and only secondarily about his modest salary raise.

In planning the role-playing situations to be used in a training program, the trainer tries to create plot situations which will be fairly sure to elicit the kinds of behavior desired. In this somewhat oversimplified illustration, the instructor may desire to illustrate various ways of reacting to aggressive behavior. He may want to demonstrate the advantage of listening and reflecting the other person's aggressive behavior, or he may simply want to provide an opportunity for a subordinate trainee to achieve some understanding of the difficulty and complexity of the supervisor's job by requiring the subordinate to play the role of the supervisor.

Generally, the particular idea that the trainer is trying to teach is quite simple. For example, most people would agree that a supervisor should be prepared to listen to an employee's story when he is obviously angry; yet, we all know that sometimes people fail to act on the basis of such knowledge. Role-playing offers the advantage of having the trainees become intensely involved in a learning experience and to fully feel the impact of a situation which is known to be artificial but still has a realistic character to it. Learning takes place simultaneously at the feeling, acting, and thinking levels and avoids the artificial separation of action, words, and thinking.

Role-playing should not be thought of as a single technique, however. It can be used in a variety of ways. A common use of one type of role-playing exercise is simply to give the trainee practice in certain skills. For example, a salesman trainee may be put in a role-playing situation in order to polish up his sales strategy, his vocal intonations, facial expressions, and so forth. To do this, of course, it is assumed that the trainer can clearly specify what particular behaviors are desired in the salesman. Role-playing is sometimes used as a demonstration to the passive trainees about how certain actions or interactions should be carried out. Another technique, called Role Reversal, requires individuals who actually hold certain positions in an organization to play a different position in the organization. For example, if a foreman or other supervisor is required to play the role of a subordinate, he may get a better feel or understanding for the point of view of that subordinate.

Gaming. The first use of gaming as a training procedure was by the armed forces in their well-known "war games." In the late 1950s, the concept of gaming was borrowed from the military in a sense, and it became common practice to expose civilian business managers to management games or simulations. In a management decision game, one or more teams—each representing a business firm or perhaps a division or department of a business firm—make a series of decisions controlling the operations of their firm during a specified period. The outcomes of each team's decisions are calculated according to a mathematical model of how the industry or business operates. The trainees are thereby given immediate feedback on the quality of their decisions.

Since the early 1960s, the full circle has been completed in that business games, which were originally inspired by war games, were re-introduced into military training—especially in courses on logistics management, depot maintenance, management of arsenal production lines, and so forth.

As you know, commanders or military managers are often called upon to make decisions on questions which have little or nothing to do with military matters. Often these decisions require specialized knowledge and skill which only a few members of the military organization may possess. Reaching a correct decision in such problem areas as those of budgeting, maintenance policies, and inventory control, is not merely a matter of choosing a course of action that satisfies all the participants in the decision process. The military manager must learn to balance different organizational objectives, to obtain and evaluate additional relevant information, and to predict the probable outcome of different courses of action.

The main purpose of management games is to give the players an awareness of the complexity of the environment in which they must operate and to train them to deal

with this complexity by effective decision-making techniques In addition to the economic aspect, the military manager must pay attention to the world-wide military and political environment. Simulations may be easy or difficult to execute depending upon whether they focus on one role or on the total role system. In the latter case, a computer is used generally so that man-man and man-computer interactions are common.

The In-Basket Test. In 1957 certain psychologists (Fredericksen *et al.*, 4) developed a work sample test known as the "In-Basket Test." It was originally intended to be an assessment technique, that is, a device for assessing the quality of decisions made by executives in relatively complex situations. The test has been modified in certain ways for various purposes, and actually serves now as a simulation, or game, in which the trainee plays the role of an executive making a series of decisions on relatively complex matters.

The Army Logistics Management Center at Fort Lee, Virginia, has modified this technique somewhat, and is using it as a technique in the training of officers for relatively high level jobs as managers of maintenance organizations. You will see that this exercise resembles a role-playing situation in certain respects. The officer trainee is told to imagine that he has just reported for duty at a certain Army depot. Colonel Ashworth, who is the trainee's commanding officer on this new assignment, has asked the trainee to clean up the in-basket of a certain division chief who has been transferred. The colonel also hints that the newly arrived officer may be given the post of chief if he performs well in this activity.

The in-basket contains some 40 or so documents including a mission outline of the depot, an organization chart of the depot, an organization chart of the depot maintenance division of which the trainee is supposed to be acting chief, and a narrative description of the responsibilities of the various branches of the organization. Most of the contents of the in-basket are memos, letters, directives, and complaints. The trainee is told: "You are to work with this material and take appropriate action as though you are actually on the job. You must do this entirely through writing on the form sheets furnished for this purpose; that is, by writing the gist of appropriate letters, memos, notes or other written communications. In the case of letters, you need only to describe what you would say. Memos and notes should be as you would actually write them and may include reminders to yourself, statements of plans, and anything else you might write if you were actually on the job. Throughout the exercise, any reference material you may have may be used."

By the end of the exercise, it is expected that the trainee will have become fully immersed in the executive role. He will certainly have a feel for the complexity of the decisions which must be made. He will be forced to become aware of the large number of factors which bear upon any decision in a complex area and of the impossibility, frequently, of arriving at a perfect solution.

The in-basket test may be used either as an assessment device or as a training device, or both.

Simulation of the Role Systems in Logistics Management. The Army Logistics Management Center at Fort Lee, Virginia, has developed another game simulation known as CALOGSIM, which stands for Computer Assistant Logistics Simulation (5). This presents the trainee with problems similar to those encountered in a Department of Defense Wholesale Supply System. The trainees are divided into operating groups, each consisting of 6 to 10 trainees. Each group represents a newly established supply management group which has just been reorganized. Each group has a manager—one of the trainees—with the power of decision. The role of manager shifts from one trainee to another as the course goes on.

The main objective of this simulation is to enable trainees to make decisions based on past experience and the knowledge they have gained while students at the

Logistics Management Center, and to "live with these decisions and the results for the period of the simulation."

Of course, the overall, broad mission of any logistics management organization is to make certain that all needed supply items are available in adequate quantities at the times and places needed. The trainees in this simulation are provided with voluminous information on inventories, repair capabilities, amount of lead time required to fabricate or repair items, etc., etc. A good deal of this information is stored in a computer and can be read out to the student when he requests it. As the game proceeds, management decisions are required in a wide variety of areas, such as procurement, normal and emergency; local purchase; re-scheduling procurements; repair decisions; transfer of stock from one category to another, and disposal of surplus property.

The exercise simulates a four-year cycle of operation. One month is compressed into a period of about 45 to 60 minutes. Certain unpredictable events, such as mobilizations, strikes, and natural catastrophes, are arranged to occur in each period and the effects of these events on the items being managed will evoke management decisions.

The computer compiles a score for each supply management group, based on its performance in such areas as cost of operations, cost of materials, cost of storage, quantity of demands not met, and so forth.

Concluding Comments on Management Training Techniques

Most of these management training techniques have very little or perhaps no usefulness in the typical military training situation--particularly when training enlisted men for specific Army jobs. They are more useful in advanced level executive training, and in the training of NCOs and commissioned officers. In general, these techniques are believed to accomplish two broad objectives: (a) They provide the trainee with emotional insights and new perspectives on how to go about tackling complex problem situations, and (b) they may give the trainee some experience in playing the role of a decision maker in complex areas. All of these methods are examples of what psychologists call "experience-based learning." The objectives of such training emphasize the process or the *how* of doing things as opposed to specific content. Training objectives are often concerned with changing behavior or providing the trainee with insights that will enable him to cope with problem situations in a more effective manner.

A caution is also in order with respect to the skills necessary to use these methods effectively. With moderate training and guidance, some trainers can quickly acquire many of these skills and come to understand what they are doing and why. In general, however, it is probably best for the uninitiated to avoid these techniques, even though they superficially seem to be quite simple.

It is probably apparent that the cost of using these kinds of techniques is high, since they require individual or small group instruction. In addition, it is often difficult to clearly demonstrate what the individual has learned. Research attempting to evaluate these approaches has not been clearly favorable, primarily because of some of the methodological problems involved. The principal methodological obstacle is the lack of a criterion—that is, it is difficult to specify precisely what it is hoped to teach in such exercises, hence it is difficult to determine whether teaching has been effectively accomplished. It has been emphasized throughout this course that a good training program should start out with clearly defined terminal behavior objectives, and this is very difficult to do when utilizing such techniques as the management training techniques just described.

Thus, we have no clear-cut empirical evidence that these techniques do justify their cost. The principal basis for their wide acceptance is simply the testimonials of individuals who have been trained with them. Most executive trainees, who have been through

procedures such as these, are quite enthusiastic about their usefulness. The simple fact that these exercises are highly interesting to trainees may, in itself, justify their use—a least in certain situations. Hours of classroom lectures can become quite fatiguing. The insertion of such activities as role-playing, gaming, and so forth, from time to time in an otherwise complete lecture course might have significant motivating values to the students and be worthwhile on that account.

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Practical Approaches to the Problem of Low Motivation in Army Trainees

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Poor motivation is a pervasive problem in Armed Forces training programs. Students who are not motivated to learn are often unable to meet course requirements. This situation results either in administrative problems where recycle or reclassification is indicated, or in the fact of inadequately trained graduates, ill-equipped to fulfill their service roles, and able to function minimally, if at all, in the jobs to which they will be assigned.

The question of motivation has important implications with regard to the adequacy of training operations, and thus to the effectiveness of manpower utilization.

What is Motivation?

Operationally, motivation may be defined as the willingness to direct effort toward mastering the information and skills prerequisite to successful completion of a particular course. The importance of motivation to successful learning and consequent effective job performance has long been noted and documented. In a group of equal-ability trainees, performance will vary from superior to inadequate: such diversity in achievement level is due to the degree of motivation to achieve.

It is not necessary to identify or to measure motivation level in order to raise it. A list of specific factors which influence effective learning and which generate high motivation may be culled from numerous studies in psychology and other fields (1, 2, 3, 4, 5, 6). A parallel guide for the application of these factors to service training problems exists in the research and survey literature prepared by service-related personnel (7, 8, 9, 10, 11, 12, 13).

FACTORS WHICH INFLUENCE MOTIVATION AND LEARNING

1. General

a. Existing Motivation. Content material and goals previously associated with interest and success have high motivation value; the individual will strive toward such goals. Conversely, material or goals previously associated with such aversive characteristics as frustration or failure serve to motivate behavior *away* from the object or goal.

The degree or intensity of existing motivation is thus directly proportional to the degree of positiveness, or success, previously associated with similar activities or goals.

b. Intrinsic vs. Extrinsic Motivation. Persons in high-level occupations tend to be motivated mainly by intrinsic factors (work content is seen as rewarding in and of itself; the act of task accomplishment is inherently satisfying).

Individuals holding lower-level positions tend to be extrinsically motivated (satisfaction is received from elements not directly related to job content, such as salary, working conditions, opportunity for advancement, fringe benefits).

c. **Emotional Factors.** Motivation increases where there is ego-involvement with the task. Given some responsibility for a job outcome, or made to feel personally involved with the results of a task, the individual will be motivated to exert himself.

When defeat is seen as personally humiliating, as injurious to the ego, motivation to succeed increases.

d. **Task Difficulty.** Motivation is in part determined by degree of task difficulty. High motivation is not aroused by a task beyond one's capacity; nor is it effected in the individual faced with an extremely easy objective. It is obvious that task difficulty is always relative to the individual faced with accomplishing it.

e. **Experience of Success.** Persistent failure in a particular area of learning or type of task will extinguish existing motivation. The experience of success is necessary for continued motivation.

2. Intellectual Factors

a. **Information and Knowledge of Goals.** An understanding of overall objectives, nature and purpose of the task, will enhance motivation to learn. Meaningfulness of the task or material, its relationship to other tasks, and its relevance to future life situations are essential to sustain motivation.

b. **Knowledge of Success and Failure.** Knowledge of results is one of the most dependable motives. When students are informed of their successes and failures they make a definite attempt to improve both their attitudes and their output. When subjects are told something about the quality and quantity of their performance, the activity assumes significance and work proceeds with specific aim and purpose. This technique will be effective with all save the slowest students to whom only negative results would be reported. It would not be beneficial in such cases to announce continued successions of failures. (See Section 1, Paragraph e.)

c. **Curiosity.** If curiosity can be aroused in the student about the material or task, motivation will be increased. Arousal of interest produces concurrent improvement in motivation level.

d. **Praise and Reproof.** Any kind of statement by the instructor on the student's work, regardless of the direction or character of the comment, is better than no statement at all. Involvement with, and interest in the student's progress, as evidenced by comment, is more effective than a neutral attitude.

Commendation, praise, and encouragement, are more potent motivators than is reproof of any kind. Negative comments, as opposed to positive statements, are inferior incentives regardless of student age or level of intelligence.

3. Social Incentives

a. **Rivalry.** Competition with one's own record and for personal rewards motivates more effectively than does a system of group rivalry.

b. **Group Motivation.** The individualistic motive yields better learning and work quality than does the social or cooperative motive.

Without denying the importance of group morale in non-classroom situations where performance or survival is a function of group coherence and collective motivation, the trainee will learn more effectively when motivated as an individual than as part of a group.

4. Punishment and Reward

a. **Definition.** Differences have been found between school- and student-defined rewards and punishments. That is, some instructor-established rewards are perceived as punishments by trainees, and some punishments are considered by students to be

rewarding. An incentive or penalty can serve the function for which it was designed only when there is student-instructor agreement as to which is which.

b. **Reliability of Reward.** Promised rewards must be given when earned. An incentive is only as effective as it is reliable. Promised rewards which are not made available when earned cease to serve an incentive function.

c. **Significance of Reward.** Incentives must be meaningful and desirable to the student. That they may or may not be attractive to those in authority is irrelevant.

d. **Punishment.** Punishment appears to be more effective in achieving conformance than in arousing motivation to achieve. Punishment, moreover, creates unfavorable attitudes that are not conducive to sustained motivation, and has only temporary influence on effort. Overemphasis on punishment is likely to decrease, rather than increase achievement.

APPLYING RESEARCH FINDINGS TO THE ARMY TRAINING PROBLEM

1. General

a. **Existing Motivation.** It is easier and more effective to make use of existing motivation than to rechannel it. Exploiting already-established motivation may be accomplished by considering past experience and interest of the trainee in classification and assignment procedures. While it is not always desirable or feasible to place men in the training area of their choice, long-term goals of both the trainee and the service will best be served when general interest and prior training are prominent considerations in placement decisions.

b. **Intrinsic vs. Extrinsic Motivation.** Despite the value of intrinsic motivation, it is probable that it rarely exists in the student faced with a service training situation. Goals tend to be pursued less for their own sake than for the extrinsic factors associated with them; learning is probably less motivated by the satisfactions inherent in the material to be learned than by related rewards and punishments. However, intrinsic motivation can be effected, at least to some degree, by instructors who are themselves intrinsically interested in the material. Their enthusiasm can generate interest in the task and the capacity to receive satisfaction from it.

c. **Emotional Factors.** Ego involvement, and thus increased motivation, can be induced by providing the trainee with opportunities for active participation in the learning task, by giving him some measure of responsibility for task outcome, and by creating an atmosphere in which personal involvement with the material is possible.

d. **Task Difficulty.** Material must not be beyond the individual's capacity to learn it. It must also be challenging enough to maintain interest and aspiration level. It would obviously be impossible to meet these requirements for all members of a class at the same time using traditional instruction procedures. The requirements could be satisfied, however, with a system of differentiation of instruction for students of various abilities. This could take the form of programed instruction or of dividing the class into homogeneous groups for part or all of the training session.

e. **Experience of Success.** Helping or allowing the student to experience success on a task will show him that he is capable of succeeding, and will motivate him to strive for similar achievement in the future.

2. Intellectual Factors

a. **Information and Knowledge of Goals.** Students with low motivation are typically unable to relate their day-to-day skill training to meaningful personal goals; they cannot see the relevance of training to the lives they expect to lead. Orientation programs should

include discussion of the applicability of material and skills to be learned both to future service duties and to civilian jobs. The importance of the Army duty to be performed should be stressed, and the relevance of each task to the larger job noted. Trainees should be given understanding, as well as knowledge, of the subject.

b. **Knowledge of Success and Failure.** A grading system with real and perceived validity, and a verbal evaluative system which immediately informs the student how well he did, will lead to increased motivation and productivity.

c. **Curiosity.** Curiosity in the material can be aroused by the instructor's positive attitude, by the degree of enthusiasm he exhibits, and by eliminating monotony and repetitive approaches to the material.

d. **Praise and Reproof.** Instructors should comment whenever possible on the student's progress. Encouragement and approval of even a small improvement are much more effective than are sarcasm or reprimand. Motivation to perform effectively is reduced or destroyed by continued reproof in the absence of praise.

3. Social Incentives

a. **Rivalry.** Pitting one class or company against another is not as effective a motivator as is establishing a system of competition with one's past record. Each student should keep a personal record or chart of his progress, and should be urged to improve upon it.

b. **Group Motivation.** An incentive approach should focus on the individual student in competition with his past record or with others in his group. This is more effective than inciting the class as a whole.

4. Punishment and Reward

a. **Definition.** Incentives should be selected or agreed to by the trainees. The student will not strive for a reward which is not valuable or important to him.

b. **Reliability of Reward.** The system of reward, as well as that of punishment, must be administered reliably and consistently. The trainee cannot be expected to strive for reward privileges which are not available when earned. The trainee will work harder for a reward he is sure of receiving than for an uncertain one.

c. **Significance.** Rewards must be significant and attractive to the student. Because reward is relative to the given individual, a choice of several incentives should be available.

d. **Punishment.** A reappraisal of the traditional Army system of punishment is indicated by the generally negative effects of punishment found on motivation and learning.

SUMMARY

The following suggestions are made to counter the problem of low motivation in Army trainees:

1. Consider trainee interest and experience in classification and assignment procedures.
2. Use instructors who show interest and enthusiasm for content material.
3. Make trainees responsible for some aspect of the learning task.
4. Differentiate training according to trainee ability.
5. Allow students to experience success with task material.
6. Inform trainees of overall meaning, objective, and relevance of task and of job.

7. Inform students of success and failure as they learn.
8. Present material in interesting ways.
9. Praise student for progress.
10. Establish individual, rather than group, incentives.
11. Clarify rewards and punishments and make them meaningful to the trainees.
12. Make rewards reliable and significant.
13. Decrease emphasis on punishment as a means of improving class work.

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Case Study of Quality Control System

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Can quality control work as a practical operating part of a training system? A case study of a quality control system for training that has been in practical operation at the U.S. Army Primary Helicopter School at Fort Wolters, Texas for several years may provide a partial answer to that question.[1] The quality control program was developed with the assistance of HumRRO Division No. 6 at Fort Rucker, Alabama and has been operating as a routine activity of the school.

The training program for helicopter flying training at Fort Wolters comprises three phases of training. At the end of each phase and prior to the next, an administrative decision must be made for each student: should he continue to the next phase, be washed out of the program, or receive remedial training before proceeding to the next phase. Since flying instruction is conducted mostly on a student-instructor ratio of one, each student proceeds through the program at his own pace. However, administrative requirements for particular numbers of flying hours and so on lead to the best students receiving some training or experience past the point of qualification for their MOS.

Functional Units of the Training System

At Fort Wolters, the three components of the training system are as follows: (a) management—consisting of the Director of Instruction, the Assistant Commandant, and the Commandant; (b) training operations—consisting of civilians on the basis of large continuing contract with a civilian corporation; (c) quality control element—a Military Flight Evaluation Division which administers check rides to student pilots. These check rides are given without detailed information about a student's performance in instruction; essentially, the checkpilot approaches each student "cold" so that each evaluation is independent of other information or opinions about a student.

Aspects of Quality Control

Special concerns at Fort Wolters come from the fact that flight instruction is conducted on the basis of a single instructor and student and so is evaluation. For this reason, the quality control system at the Primary Helicopter School is very concerned with standards and uniformity and has a major mission of establishing and maintaining consistency in conducting and evaluating flying instruction. Evaluation in training is devised to separate carefully and thoroughly two steps: the making of the observations of a student's performance, and the way—and mechanisms of how—observations are used to develop an evaluation.

The quality control program at Fort Wolters can be considered from the point of view of earlier discussion of quality control systems.

[1] John O. Duffy and Carroll H. Colgan. *A System of Flight Training Quality Control and Its Application to Helicopter Training*. HumRRO Consulting Report, June 1963.

Training-Testing Objectives

For helicopter training, the terminal task objectives consist of things called maneuvers—tasks such as "normal take-off," "normal approach," "basic autostation" and so on. These tasks are shown in Table 1, which lists the 17 terminal training objectives for a particular phase of helicopter training.

Table 1

Maneuvers and Component Flight Items

Maneuver	Number of Flight Items
1. 90° clearing turn	4
2. Normal takeoff	9
3. Traffic pattern	21
4. Normal approach	15
5. 180° clearing turn	4
6. Maximum performance takeoff	11
7. Traffic pattern	21
8. Steep approach	15
9. Basic autorotation	17
10. 180° autorotation	22
11. 360° clearing turn	4
12. Running takeoff	15
13. Traffic pattern	21
14. Running landing	18
15. Forced landing	23
16. Forced landing from a hover	8
17. Hovering autorotation	8

As can be seen in Table 1, each maneuver consists of four or more components, called "flight items." These flight items are the component skills and knowledges of the terminal task objective and comprise the enabling objectives for a maneuver. Flight items include "RPM," "Altitude," and so on.

Measuring Instruments

A special form was devised to allow the checkpilot to record performance on terminal objectives and on enabling objectives while they are taking place. A page from this instrument called the Pilot Performance Description Record is shown in Figure 1. This is only a small part of the evaluation procedures, but it is a critical ingredient; it is used to *record* observations of a student's performance on a standard checkride which consists of a particular set of maneuvers to be performed in a particular order. In addition, information on conditions, general evaluation, and other items are recorded as shown on Figures 2 and 3.

For pilot training, the way in which student performance is evaluated calls for careful standardization. Skill and standardization in evaluation is accomplished through a special training program for checkpilots, instructing them on what rules are to be used in evaluating observations as recorded on the PPDR. In addition, new checkpilots are given a set of PPDRs to score, with feedback on where they departed from standard school procedures. Since considerable elements of personal judgment enter into evaluation, and

over a long period the standard rules may slip a bit, the quality control system at Fort Wolters includes special mechanisms to keep track of the standards a check pilot is using. In this way more or restandardizing training can be given to those checkpilots who slip away from standards for observing and evaluating student pilot performance.

Performance Evaluation Page From PPDR

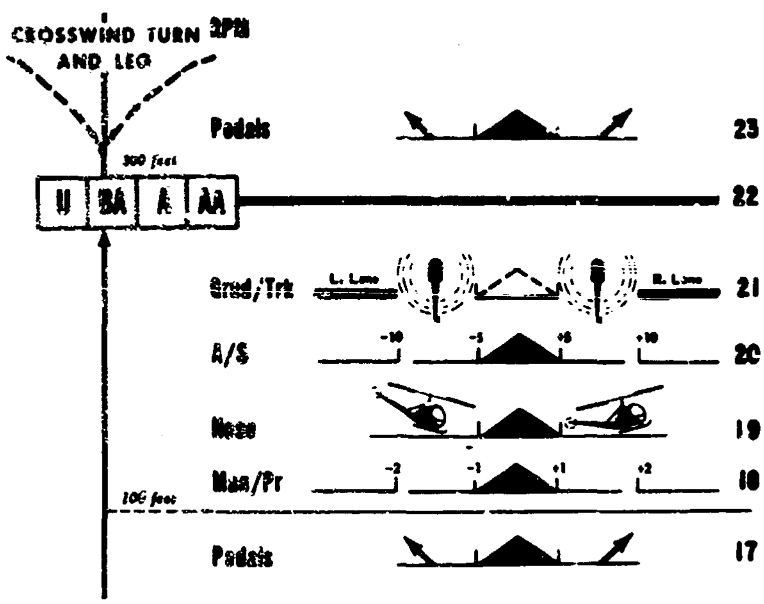


Figure 1

General Evaluation Page From PPDR

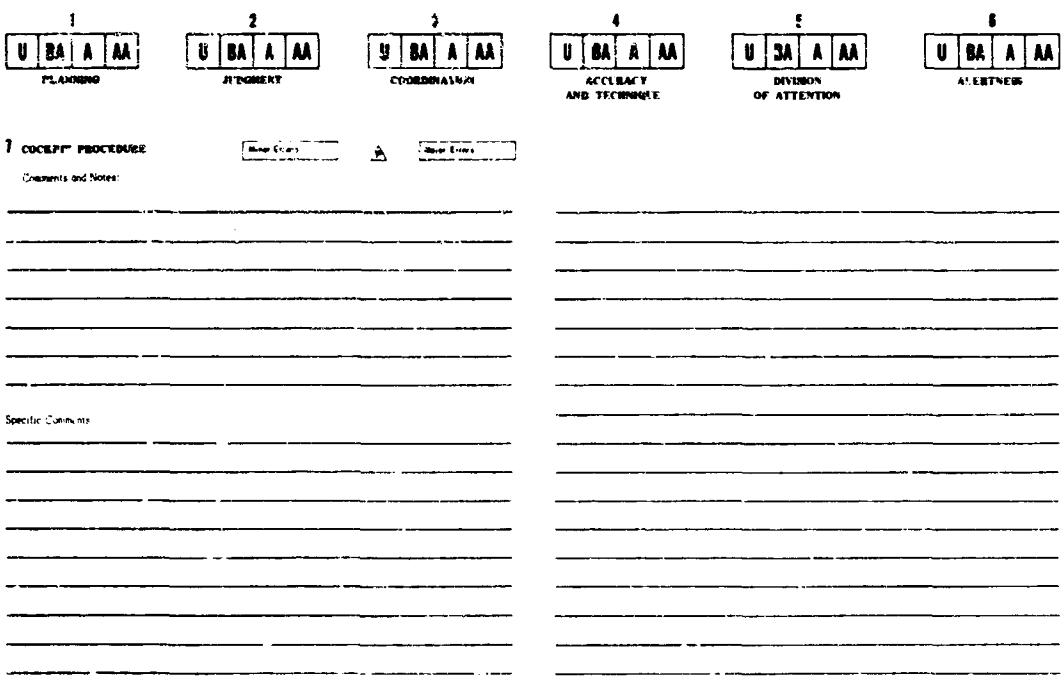


Figure 2

Information Page From PPDR

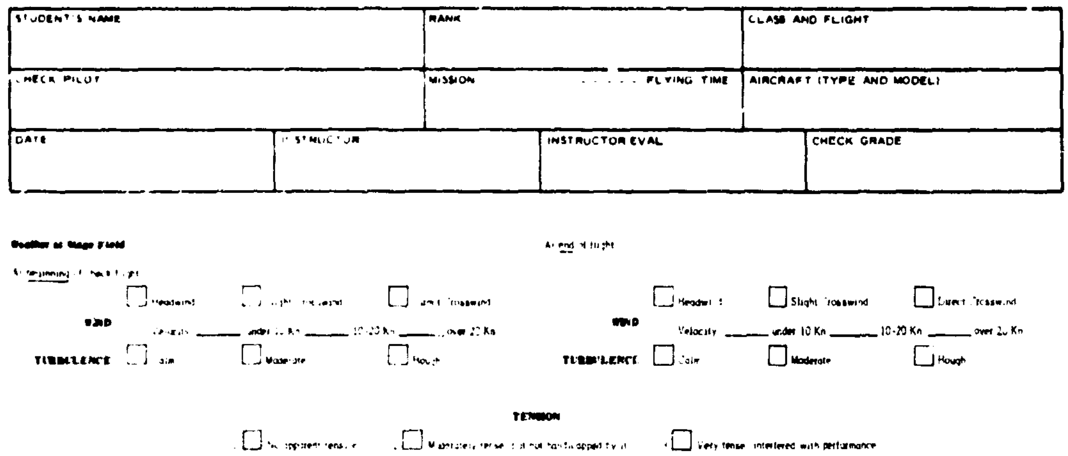


Figure 3

Data Reduction

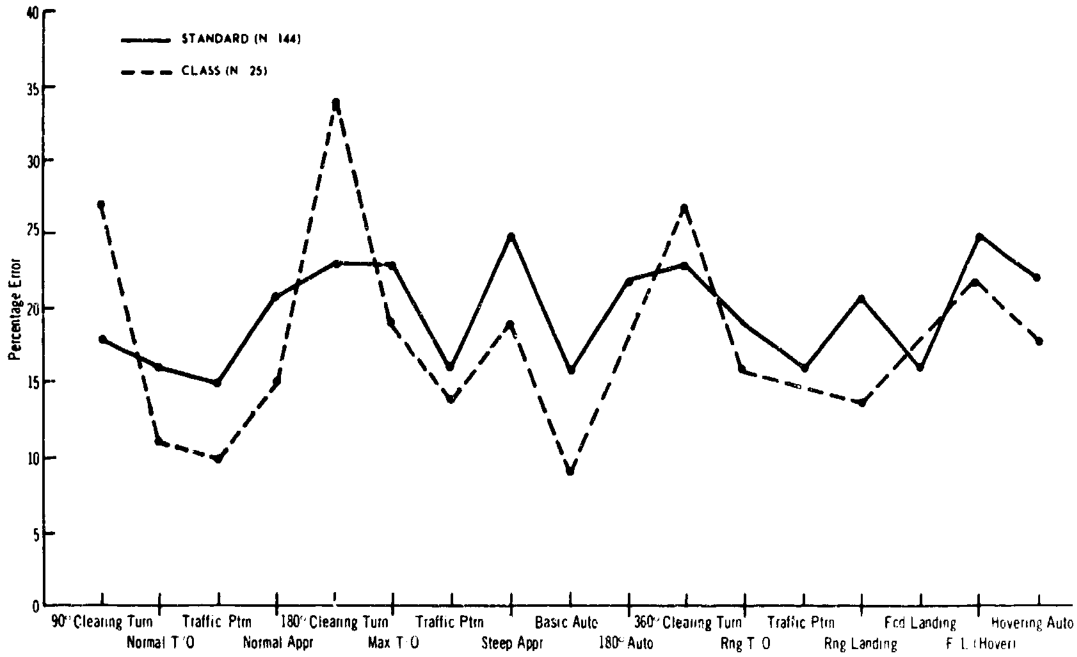
At Fort Wolters, three main kinds of decisions and actions take place. First, performance of each student is compared with specifications so that a decision may be made as to whether the student passed that phase of training, failed it, or should receive more instruction for that phase of training. Second, information on total class performance on each maneuver is developed, to determine what proportion of the class performed up to standard. These data indicate how well a class matches previous experience of the school with regard to each of the terminal training objectives of that phase of training. Third, for a maneuver that is being performed below standard by a class, analysis is made of the enabling objectives (flight items) to provide diagnostic information for a particular maneuver. These data may then be compared with school norms to help identify why a class has performed below standard on a terminal objective.

The last step in data reduction consists of using a set of statistical tables to identify the kind of action that should be taken for each terminal training objective or maneuver. Essentially, these action rules are geared to how much difference a class has shown from school experience and brings together information on the amount of variation from standard performance, the standard deviation for that maneuver, and the size of the class. These data are interpreted in order to identify maneuvers for which it is mandatory that corrective action be taken. In addition, where there is a smaller amount of deviation from norms, "optional action" is identified. Where performance is within tolerances no action is indicated. In the Fort Wolters system, only falling below standard is used as the basis for considering changes in training; no action is identified for maneuvers on which performance is well above standard.

Presentation and Communication

Presenting data for management, training operations and the quality control element is done mainly by means of simple line graphs. Figure 4 shows information on terminal training objectives prepared for presentation. The solid line indicates standard performance; the broken line indicates a particular class performance. For enabling objectives, when performance on a maneuver has been below standard, the form shown in Figure 5 is used to present the data.

Average Percentage Error on Maneuvers for Class vs. Average Percentage Error for School



NOTE: These graphs were prepared from a version of the PPDR earlier than the one currently in use at USAPHS

Figure 4

Class Performance on Critical Maneuvers (Errors vs. Items)

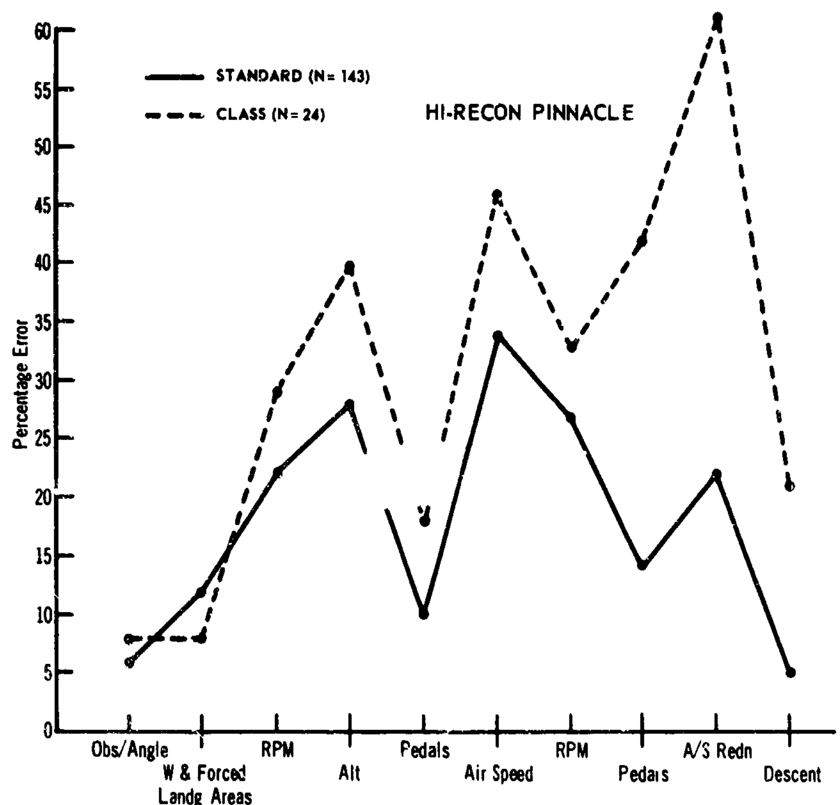


Figure 5

Since performance data must have added background information about special events for it to be clear whether anything should be done, the quality control element prepares a simple report on a Disposition Form, as shown in Figure 6. This form is used to call attention to the data of importance with regard to a particular class and is also used to record any special factors such as poor visibility or poor weather that should be taken into account in interpreting the information displayed on the graphs.

Class Performance Review Report

DISPOSITION FORM

SECURITY CLASSIFICATION (If any)

FILE NO. AKPWO-HST

SUBJECT BASIC PERFORMANCE (CLASS______)

TO	FROM	DATE	COMMENT NO. 1
Commandant and Assistant Commandant	Chief Flt Eval Div		Quality Control Coordinator

Thru:

Chief
Opns & Tng

1. The flight performance of Class______ for the Basic Stage of training was satisfactory for all maneuvers except <u>High Recon for Confined Area</u>, <u>High Recon for Pinnacle Operation</u>, <u>Take-off Preparation from a Pinnacle and Slope Operation left skid</u>.

2. Class performance shown in inclosure #1.

3. Maneuver performance for weak maneuvers shown on inclosure 2 and 3.

Chief
Flight Evaluation Division

Inclosures: A/S
Copy furnished contractor

DD FORM 1 FEB 50 96 REPLACES NME FORM 96, 1 OCT 48 WHICH MAY BE USED

Figure 6

Questions Treated in Quality Control

As for any training system, there are a number of different decisions or actions that take place from the data computed in a quality control system. At Fort Wolters, there are five kinds of recurring questions important in that training system:

First, action must be taken for each student—pass, fail, more training, another checkride, and so on.

Second, decisions and actions are taken with regard to the strengths and weaknesses of the training system for each terminal training objective, using information about performance developed out of analysis of performance on enabling objectives.

Third, the strengths and weaknesses of each instructor for each terminal and enabling training objective can be a basis for decision or action. Since there are so many instructors in an aviation training system, this is especially important to training operations and management.

Fourth, data on checkpilots are of importance to determine whether a pilot has slipped away from standard evaluation procedures. As can be seen in Figure 7, a single checkpilot is compared with normal practice; these data might suggest that since so many of his evaluations showed defects on turns, 180° and 360°, the standards he is using for evaluation may be more rigorous than intended by the school.

Fifth, checking can be done to see whether any long-term changes in training effectiveness have occurred in a gradual way over time. This is answered by preparing data as in Figure 8 to determine how present training compares with the long-term picture.

Comparison of Record of a Single Checkpilot With Record of All Checkpilots

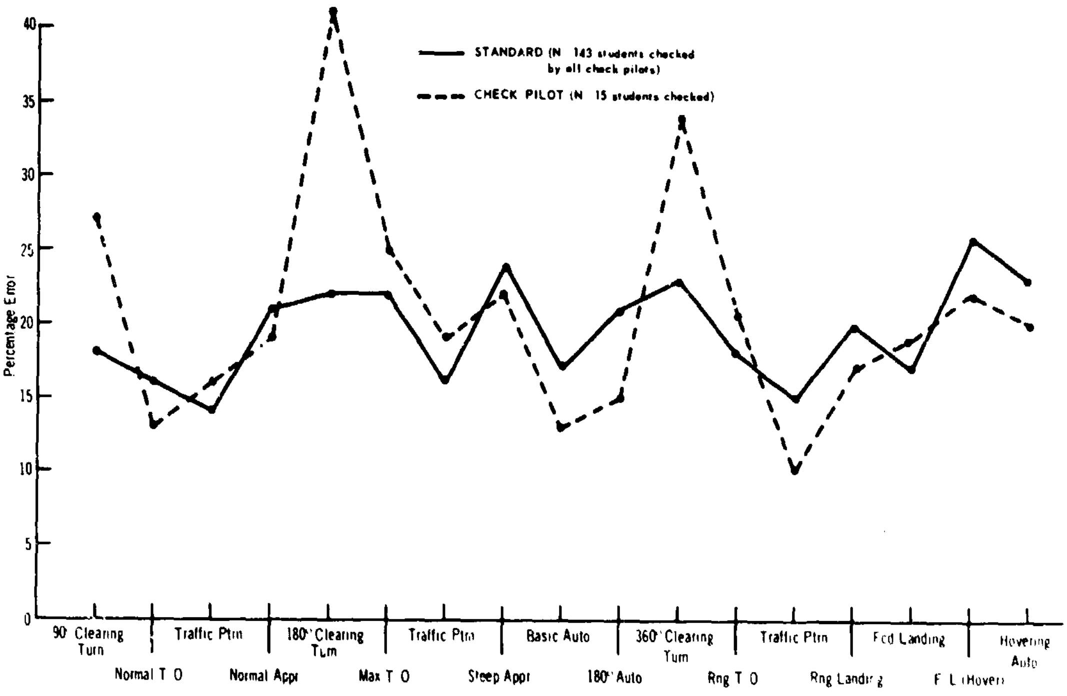


Figure 7

Comparison of a Short-Term School Record With the Long-Term School Average

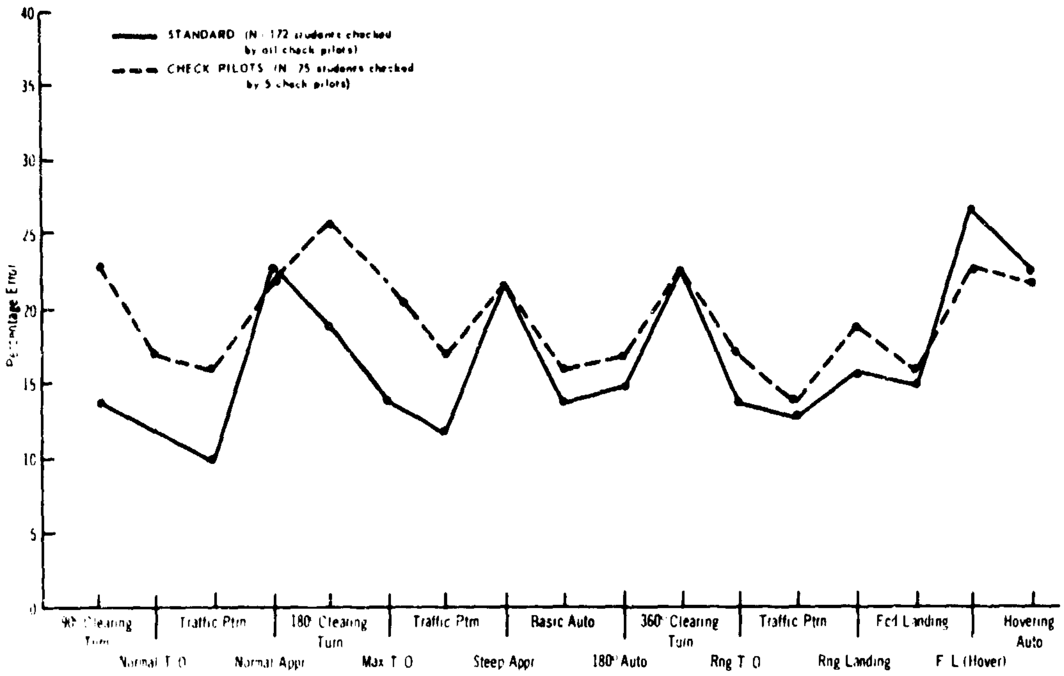


Figure 8

Interpreting Data for Action

First, the information developed out of quality control is made available throughout the training system, to management, training operations, and, of course, to the quality control element. Whatever information exists in the form of special factors such as weather or other unusual things is carefully integrated with the data procedures by the quality control system so accidental happenings can be screened out to avoid confusion. For whatever terminal training objectives are below standard, information on how well the enabling objectives have been learned is explored for diagnostic purposes. When this has been done, management, training operations, and quality control personnel meet to consider what, if any, action should be taken to modify the way in which training is being conducted for particular maneuvers. Both the data and information on graphs and special circumstances are considered with all other aspects of training to determine whether modifications should be made in the training system.

Emphasis has been placed on routine applications of the data bank at Fort Walters. The long-term data are also available to allow answers to special questions that come up from time to time, and have been found to be a valuable aid to management in many different ways for many different actions.

Communication of Results—Data Reduction, Analysis, and Presentation

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In order for information to be of use, careful attention must be given to processing it into a form that is readily usable. The way information is processed comes from the objectives, purposes, or questions for the information system.

Questions for a Training Quality Control System

The questions for quality control are those important in the training system, to management, quality control people, and training operations (1, 2). Questions should bear on things about which something can be done—to a potential action. For a training system, there are five kinds of questions that have potential action or decision implications.

Quality of a Class. How effective has a particular run of a continuing course been in teaching the trainees? This general question is for everyone in a training system and comes from the need for general information on how well instruction is going. The quality of the products—trained soldiers—tests how effective instruction has been and is the basic criterion for the training system.

Quality of the Student. Should a student be graduated? An administrative decision is needed for each trainee who has been through the training program. Such decisions are: pass, fail, or remedial action before graduation (e.g., recycle). Information about the quality of each product of the training system is needed for such personnel administrative action.

Effectiveness of Training for Each Task. How good are each of the parts of the training program? This question is related to the general question about quality of a class, but it consists of the *details* of training for each objective of the training. Detailed information about how each objective has "come through" allows direct decision and action regarding instruction and provides basis for improving or modifying training for a task.

Diagnosis of Training Problems for a Task. How can we tell what to do to improve training for a task? Achievement testing on the enabling objectives plays its critical role here. From data on enabling objectives that are well conceived and represent the ingredient of terminal objective performance, what has gone wrong in training for a terminal objective is pinpointed.

Other Systematic Features of the System. What other things are having effects on training? A program is affected by many things outside the training system. For example, the recently changed Armed Forces Qualification Test (AFQT) requirements, which introduce personnel with lower aptitude scores into the Army, might affect the effectiveness of a training program. With detailed information available from an ongoing quality control system, the effects of lowering AFQT could be determined by analyzing the performance of trainees in relation to their AFQT scores. One might learn from such study which, if any, portions of training are ineffective for the new input of personnel. Such information can be used to change portions of training for all, or, perhaps, lead to special remedial or "dual track" portions of the training program.

The potential number of questions about "other systematic features" is large; many that might be important to management, training operations, or the quality control unit could not be answered because information not a part of the quality control system may be lacking. Those questions of a continuing sort can be provided for, so that all information needed for them is part of routine data collection. Often, special unprogramed questions can be answered by special analyses of the basic data collected in the quality control system.

Data Reduction

A long column, containing many numbers bearing upon something important, gives the feeling of understanding what they mean. This very often belies the reality. For data to be understandable or useful, it must be *reduced* so that the meaning is clear and the decisions can be made. Data reduction generally involves three kinds of considerations which apply to processing information from a quality control system as well as to other types of information.

Central Tendency. First, data should be processed to show performance of a group overall. Technically, this is called calculating a central tendency, most familiar to you as an average. An average or mean is not the only way in which central tendency can be represented. Perhaps most useful for management in a training system is a form of central tendency called percentage—the percentage of a class able to perform a task at or above minimum standards.

There is an important difference between two sets of scores with the same central tendency if all in one set are alike and those in the other range widely. As in illustration from instruction, a group of trainees each of whom had an Army Classification Battery (ACB) general technical area score of 100 provide a group with average "intelligence." The group's vocabulary level would be alike, their ability to understand complicated things alike, and so on—that would be an instructor's dream because instruction could be provided easily in a way that everyone would understand. On the other hand, another group with the same central tendency on ACB general technical area of 100 but comprised of trainees who have scores going from 40 through 160 is not at all the same as the first, and teaching this group would be much more difficult even though the average is the same as for the first group.

The kind of difference between the two sets of scores can be represented in data reduction as variability. The range of general technical aptitude area (GT) for the first group is zero, the group was very homogeneous. For the second, the range was 120—a very heterogeneous group. The range is a common and convenient measure of variability but is influenced sharply by a few scores that are extreme. For example, suppose that out of 100, 98 were GT of 100, one was 40 and another 160. Technically, the range is 120 but does not represent the group very well because it is a very homogeneous one with two variants rather than a group that ranges widely.

For greater precision in characterizing variability, more sophisticated measures of variability have been devised. The best known of these is the standard deviation which amounts to an index of the average amount of difference scores show from the average. Using standard deviation, the group for which everyone was 100 has a standard deviation of zero, the group ranging widely would have a large standard deviation, the group with only two variants but all others at 100 would have a standard deviation slightly higher than zero.

Accidental Factors. Another kind of index of importance in data reduction concerns the effects of accidental factors. This notion, or "chance", represents a confession that there are lots of little things that have had small effects and it is not at all clear what

they are. Massive deviations cannot be dismissed as "something or other caused it, we don't know what," and require searching for an important factor that would lead to a major difference.

Mathematical statistics have provided a tool to gauge how much deviation may be tolerated as accidental and incidental, and when a deviation should be considered to be beyond the magnitude to be expected from lots of little variations that do not have systematic importance. This tool is called a standard error and comes about by combining two bits of information about a set of numbers. The first bit is the variability—the more variable a population, the bigger the time to time variation that should be expected in central tendency even though nothing very important might have happened. The other bit of information is simply the size of the group—the larger the group, the less its summary statistic is subject to variation from time to time. Both the standard deviation and the size of group are put together—the standard deviation divided by the square root of the size of the group. This number provides an index of how stable the basic data are and what kinds of deviation are properly attributable to "chance alone."

Data Analysis

With data reduced into something representing central tendency, something representing variability, and something representing stability—or the effects of chance—the next step is analysis. In dealing with analyzing or interpreting how a set of observations match standards, there are three aspects that enter into the picture. First, how does the central tendency compare with standard? Has the class performed above, or below, or at standard? Second, does class performance fall within tolerances established for the standard? Third, and important in developing tolerances, how critical or important is the task to operational performance? The reason for this is rather straightforward: A deficit in performance on something that is good to know but not very important, carries implications for corrective action of low priority; deficit in performance on an extremely important training objective warrants high priority for action to do something about it. This factor of importance is accommodated for data analysis by attention in setting the standard and setting the tolerances for the standard.

Analysis of data is for action that might be taken following analysis. It has been found useful to think in terms of three concepts guiding action. A highest priority for action is for those cases where data analysis shows performance is seriously out of the tolerance range. The decision to "do something" in this instance may be called *mandatory*. Procedures should be established to diagnose what problem exists and determine what should be done; these should happen automatically. A second order of action or decision for action may be called *optional* and occurs when performance is out of desirable tolerances but not sharply so. Here it might be good to look into improving that part of the program, but only if more important things are taken care of first.

If things are going well, it is nonetheless useful for some portion of the training program to be reviewed following each cycle of its administration. A convenient way to establish what portion should be reviewed, and also to establish how much review should occur after each cycle, can be developed out of the effects of chance. The logic is from formal statistical theory on the operation of chance effects but, nonetheless, is fairly simple. It amounts to the idea that assuming nothing important has changed in the way things are going, there will be accidental fluctuations varying in size. Under the assumption of chance fluctuations, a tolerance level could be set for tasks so that it is likely that a definite proportion of the tasks in training program would turn out to be candidates for exploration—even though there are only chance fluctuations. An approach of this sort has a built-in safety feature to protect the system against real change being treated as chance fluctuations because we can predict how many and what degree of deviation from

standard are likely to occur by chance. Real changes and magnitude would lead to much more and much greater deviation than chance alone, and, therefore, rules on decision for action would identify things for diagnosis and study regardless of work load when something serious has gone astray. In short, data analysis can be readily managed to lead to the following kinds of characteristics:

a. Establishing a normal routine work load for continuing study of the training program when everything is going well.

b. Identifying points and places that are "suspicious" and, if practical, warrant looking into.

c. Identifying points and places where something rather serious seems to be out of tolerance and something must be done. The mathematics and statistics underlying putting all these together in the form of standards and tolerances are rather specialized and somewhat technical, but they produce unusually easy guidelines for action after a small amount of careful mathematical combination of the several features in the quality control system.

Data Display or Presentation

There are many possible ways to present data. For our purposes, we may consider the kinds of things that can be readily accommodated in a single but sophisticated data display. It is possible to put onto one piece of paper in a simple graphic fashion information on all of the following for a number of tasks: the standard, tolerances (including the implications of criticality), and decision points.

For those items for which action may be indicated, detailed diagnostic analysis and display can be provided by processing information on the enabling objectives. This can be done by reducing, analyzing, and presenting information on all of the component skills and knowledges for any tasks for which overall performance indicates action should be taken. Here too, information on standard, tolerances, and so forth may be included.

Interpretative Reports

Data collection, reduction, analysis, and display are not enough. In addition, it is necessary to interpret the data. Occasionally, a data display may indicate something was seriously wrong with training but this may not be the case. For example, firing proficiency data collected during bad weather may show poor performance, although training was very effective. Knowing the weather was poor might put a rather different perspective on the data and seeming indication for mandatory corrective action.

The quality control section, as part of its job, must take the raw data as displayed and ascertain what, if any, additional information is needed to make sense of the information. Interpretation and additional information are most usefully provided in the form of an interpretive report summarizing the outcome of a cycle of training program. These reports should go to both management and training operations and serve as vehicles for helping identify occasions for corrective action.

Corrective Action

The last step, and the step for which everything else has been preliminary, concerns doing something where something should be done. It is very attractive, especially for a brand new quality control system without experience data, to decide that everything "wrong" indicates training operations is just not doing its job. However, corrective actions should include considering all elements in the system, including the amount of time devoted to the training program overall, the degree to which training objectives are possible to achieve, the ways that training might be improved, and so on.

The most important thing in a quality control system and the most important concept is that management, training operations, and quality control are all three arms of a single thing called the training system and, while there are a set of very important command relationships and a set of missions assigned and other ingredients in any military system, the key concept underlying an effective quality control system is information. From the information, all aspects of the training process—from training objectives to measuring instruments—warrant reconsideration to explore where things should be changed. Simply focusing on training operations alone is not enough.

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Information for Quality Control

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Two key ideas for quality control in training are information—the essential ingredient—and system, pulling together different groups to achieve the common objective of producing well-trained soldiers.

Training Objectives as Keystone

For quality control, crucial information derives directly from training objectives. They form the keystone for a useful and effective quality control system by providing not only the specifications for instruction but also the specifications for evaluating instruction (1, 2). Thus, we must begin with a complete set of good training objectives for a training program, and these objectives represent the mission of the training system.

Management plays the beginning role with regard to training objectives by defining exactly what is to be accomplished by the training system. The raw material for such defining comes from many sources—doctrine, plans, specifications for new equipment, information about how earlier graduates of a program have performed in the field, information about field needs, and so on. The management element assembles all such information and decides on terminal training objectives. In order for the terminal objectives to be most useful they should be in the form of detailed specifications.

With terminal objectives defined, training operations is responsible for developing detailed enabling objectives and then producing graduates who can perform as defined by management.

Adapting Terminal Training Objectives for Quality Control

The quality control element begins its activities mainly from the terminal objectives but also secondarily, from enabling objectives. It measures to what extent specifications are met in training operations, and it serves management directly with terminal objectives data, and training operations by providing information on the enabling objectives.

Special procedures are used to adapt training objectives to provide instructional content for a course. Training objectives also need to be adapted for use in quality control. The set of terminal objectives forms a complete inventory for evaluation. Training objectives also include information about the conditions under which tasks are expected to be performed and thereby define test conditions. Further, training objectives also include the standards or tolerances for the task in terms of accuracy and speed requirements; these are also tolerances for use in scoring an individual's performance on a task.

In order to assess the effectiveness of how the training system is performing, another kind of information is needed about each task—the minimum acceptable percentage of students capable of performing within tolerances. Cost and time aside, it would be desirable for every man to be able to perform every task within defined tolerances. However, achieving such a goal would be likely to make cost and time for training intolerably large. Something short of 100% of the students capable on 100% of the tasks must be defined by management as an acceptable tolerance for the effectiveness of the training system.

Adapting Enabling Training Objectives for Quality Control

Terminal objectives are most usefully thought of as represented in a final test and evaluation procedure given at the end of training for information on operational capabilities of graduates. The enabling objectives also represent a set of instructional goals, but they have to do with the details of an operational task rather than with how well the task is performed. The "consumer" of graduates and the management of a training system are mainly interested in operational capability and only secondarily interested in how it is achieved. What then is the role of enabling objectives in the quality control system?

If the enabling objectives have been properly developed, they represent essential components in performing the terminal training objectives; if an enabling objective has not been accomplished in training, it should show as degraded performance of one or more terminal objective tasks. The "nuts and bolts," exactly what has gone into the training process as enabling objectives, is of most direct concern to training operations. While training operations needs information in detail about terminal objectives, whether particular skill and knowledge components of a task have been learned by trainees is critical to them. Adapting enabling objectives for evaluation and testing amounts to collecting diagnostic information for training operations so that they may develop details of how to adjust training to foster accomplishing terminal training objectives.

To review, management is primarily concerned with whether terminal objectives have been accomplished. Testing for this purpose is called proficiency testing and is normally given at the end of a training program. Training operations, while interested in the results of proficiency testing as feedback on terminal training objectives, is especially interested in *diagnostic* data on the enabling objectives or components of a task. Testing for this purpose is normally called achievement testing and is given as part of the ongoing instruction process. The quality control element, in its role to develop and provide information for management and training operations as well as for its own purposes, is interested in both proficiency and achievement testing.

Kinds of Information

To support a system for the quality control of training, three categories of information are needed. First is information on standards, both standards of performance for a task and standards for training program effectiveness. Second is proficiency information, the extent to which graduates of the training program can perform the activities needed in the field. Third is achievement data, the extent to which graduates know or can perform the component skills and knowledges that are the elements of the terminal task objectives.

A quality control system rests very heavily on the training objectives for the program and their quality—both for the terminal and the enabling objectives. Test and evaluation procedures are adaptations of training objectives.

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System View of Training and Quality Control

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As part of the extensive industrial mobilization for World War II, some new ideas had to be developed in order that the energies of the nation be redirected and increased in support of the war effort. A great deal had to be done; it had to be done very quickly, and it had to be done effectively. Managing that kind of explosive mobilization required not only the use of the best management talent in the nation but also rapid development of new approaches to management and new management tools, such as quality control systems for production and procurement.

The need to assure the quality of materiel for the Armed Forces by the War Production Board, military procurement groups, and other federal agencies led to application of the talents of statisticians and people who now would be called "operations researchers" to devise formal systems for the inspection, analysis, and feedback to producers about their products. These systems helped procurement to proceed in an effective and orderly fashion for both industry and government.

In the aftermath of World War II, industry—probably with great surprise—realized that the quality control systems imposed upon them had tremendous value in the production management for their normal civilian-oriented production. With this realization, quality control systems were established, or continued, in all major industrial complexes to serve as management tools for improving operations, increasing profits, and assuring quality of production.

The reasons for a quality control system apply directly to a training system which is a "production" mechanism "manufacturing" trained personnel. Benefits of quality control systems for training are being felt in the Army, and this management tool is certain to be applied to training more and more broadly as the needs for training continue to increase.[1]

Functional Units of a Training System

A training center or a school, a military unit engaged in training, or a collection of such elements can be thought of as a training system. Training systems, from the perspective of quality control, consist of three elements: management, training operations, and a quality control element. While management, in the military, is most often called "command," the point of view for training quality control is most closely related to information systems rather than to command systems and, for this reason, the term management is used.

Normally, a separate element called "quality control" is unusual in military organizations; quality assurance is most frequently a command function. However, to emphasize information flow as the key concept for quality control, it is best to conceive of a unit serving the quality control function that is separate from the unit doing managing.

Training operations as a term fits very naturally into normal military settings and terminology. Training operations is the portion of a center, or school, or unit normally

[1] Paul W. Caro, Jr. *Flight Evaluation Procedures and Quality Control of Training*. HumRRO Technical Report 68-3, March 1968.

called the G3 or S3—the training facilities, instructors and so on, all engaged in training operations.

Objectives of Quality Control

A quality control system is used to provide sound information to guide decision and action for a production system. A quality control system for training can provide information for three main kinds of management decisions and actions.

Individualized Training. The future of training operations is directed in many ways toward "customized" training for students. Individualized treatment of the future will consist of more and special training for those who need it and shortening of training for those able to learn rapidly. In addition, programed instruction, computer administered instruction and other technological developments will allow instructional material to be closely tailored to each student. These concepts of variable time and tailored instructional material exist to a degree in present day military training activities. Not all students are ready for duty at the end of a normal military occupational specialty (MOS) qualifying course. Some are recycled so they may learn more before duty in a unit; others receive formal or informal remedial instruction in the field before they are put on effective duty status.

With a quality control system based on sound information, and by exploiting advances in the technology of training to tailor instruction to each student, pinpoint "remedial" training can be automatic and happen for all trainees.

Accelerated graduation from a course is unwieldy at the present time; in fact, it is not possible in many cases where congressional law or Army regulations require a particular amount of training for a man to be MOS qualified. Administrative criteria, such as number of hours of training, can be replaced using performance data assuring that a man can perform the activities he is supposed to perform. However, in order for graduation to be based on proficiency, sound and detailed information about a man's capability is needed.

It appears very likely that the Army and other services will shift heavily and rapidly towards individualizing training. To exploit the gain in training efficiency, sound and reliable information systems will be necessary to provide for the measurements needed in the training system.

Quality Assurance. The original purpose for devising quality control systems for industry was quality assurance. Parallel to these in military training are criteria used to assign a man to a job or give him a MOS. Generally, these are administrative in nature (e.g., eight weeks of training), but proficiency testing is also used. Qualification based on proficiency is illustrated by marksmanship, for which qualification as marksman, sharpshooter, or expert depends on certain prescribed performance on the target range.

Quality assurance and emphasis on job-based training objectives provide a basis for shifting from reliance on the indirect administrative criteria to proficiency for a job criterion provided that an information system in support of such shift is available. To do this, one must begin with the specifications of standards for the behaviors that are required and the tolerances that may be allowed for the set of tasks comprising a training program. By using evaluation procedures based on the specifications, a meaningful and functional procedure for awarding a MOS or allowing graduation from a training program is available. Historical emphasis on administrative criteria may reflect reluctance to use evaluation data to award an MOS without evidence that the measures are clearly geared to exactly what the man needs to know to perform the terminal objectives of a training program.

Program Improvement. Training programs are continually in process of improvement and updating. The roots for change tend to be command decisions. For example, a

decision that the soldier needs more training for night combat leads to increasing the amount of night combat training. Data management uses for such changes are both formal and informal inputs from field commands, doctrine changes, plans, technical specifications for new equipment, and so forth. Change in a training program based on such sources of information is very important. A sound quality control system also allows the *product* of the training program to continually provide information about training of a different sort. Detailed information on a group of soldiers finishing a training program can be studied to identify places where the training program may be relatively inefficient. Such data can be used to allow continuing improvement on a routine basis.

Aspects of a Quality Control System

There are six critical aspects, all of which are necessary, in order that a quality control system be useful, effective, and efficient. **First,** it must begin from a set of training objectives which not only form the basis for the detailed development of a training program but also identify the subject matter to be covered in the training and evaluation procedures. **Second,** the objectives must be converted into a set of good measuring instruments. **Third,** data reduction and data analysis must take place to convert raw information to a practical usable form. **Fourth,** data communication procedures and formats must be developed so that the information can be readily presented to management, training operations, and the quality control element of the training system. Communication also includes administrative procedures for information routing. **Fifth,** procedures for improving training must exist so that the information gained from a quality control system can bear its major fruit—the continuing improvement of the training system. **Sixth,** and perhaps most difficult and important of all, there must be thorough support from management for the concept of quality control as an information system to work.

There is a very important distinction between command and management. A commander takes the role of assigning a mission and holding the operating unit responsible for fulfilling it. An information system approach is from a perspective that the three elements of the system—management, training operations, and quality control—share the mission of producing well-trained personnel. Quality control data must be viewed as "here is *our* problem, what can *we* do about it," not "training operations is not doing its job."

Support form management is especially needed because data developed by a quality control unit may be unpleasant—something may not be going well in thus and such a portion of training. Neither training operations personnel nor management nor—hopefully—the quality control element will be happy about it. However, if the information is directed toward finding out what can be done, quality control can be viewed as important to the shared mission of management, training operations and quality control—thus assuring a well trained man and the continuing improvement of training.

Learning and Performance Concepts

Donald F. Haggard
HumRRO Division No. 2

The primary purpose of this course is to provide the command personnel who will be largely responsible for future training management with the tools that are necessary to develop effective training programs. In preceding lessons we established the bases for this program development, that is, systems mission analysis, performance standards, and training objectives. We indicated that this sequence of activities is necessary to determine the training course content—its extent and value. With this information, we are now ready to construct the training program—to specify, for each course period, what the instructor will do, what the trainee will do, and what supporting instructional materials and teaching aids will be required.

Now that we have reached this point, we are going to become increasingly aware of two inadequacies in our present efforts. First, we are usually concerned only with administrative matters and totally neglect the psychological considerations of the type of training we can give. Second, even when we do attempt to consider the psychological requirements of the program, we often find that the information needed is inadequate or unavailable. At the end of this program it may appear that we have, in effect, built a bridge with strong abutments on each side and then blindly thrown a rope across to span the river (Figure 1).

On the one bank, we have built up the art of writing objectives to the point where no one other than the people who are trying to write them, will question the utility and beauty of the training objective. Today everyone—including military trainers—is busy writing objectives. On the other bank, we have been developing the procedures for personnel evaluation since World War I. But what has been happening in between? For the most part we have been standing still, content to bridge the gap with training programs that are based largely on administrative criteria—time, cost, facilities, instructors, and so forth—while the decisions concerning the particular techniques that are best suited for the instruction are almost completely overlooked. Today we are far more concerned with such things as budget and preparation time than we are with the effectiveness of the training we can provide.

Components for Training

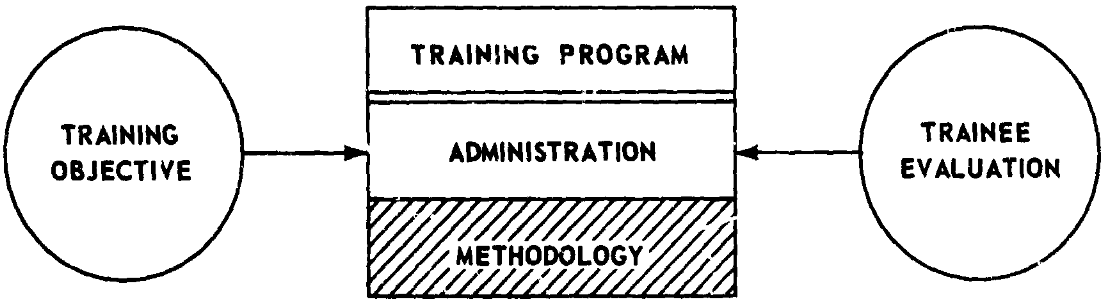

Figure 1

This fact is well illustrated by a recent study conducted at a large aircraft company (Walker, 1). In this study, training specialists were asked to list all of the factors they used to select training techniques. The results are shown in Table 1.

We can see that there is an almost total dependence upon administrative criteria, such as the time that can be allotted to training; facilities needed to prepare and present the material; student input numbers, qualities, and so forth. Concurrently, the study shows an almost complete disregard for training methodology. With the exception of student motivation, the subtler methodological elements which significantly affect the training process are overlooked. There seems to be no concern with questions of student feedback, retention, pacing, or competition, and little concern with student participation and reinforcement, training realism, or transfer of training. These "student-centered" items are the heart of the training program. Yet, it is probable that these results would be duplicated if we were to make a similar survey of military training specialists. Thus, many present training programs are ineffective because the planner became so embroiled in administrative duties that he completely neglected the questions of methodology.

Thirty years ago this would not have been a problem. At that time, training objectives were simple and the determination of training methods was as uncomplicated and elementary as was the list of techniques from which one could choose. However, equipment—and the related skill and knowledge requirements—have become progressively more complex. With this increase in equipment complexity and engineering knowledge, there has been a concurrent increase in training complexity and knowledge. We have engineered a whole new family of training media—methods for presenting knowledge of skill. These have progressed from yesterday's simple lecture or film combined with practice on the actual equipment, to today's television training, automated programs, and computer-assisted instruction combined with practice on sophisticated devises and simulators. Furthermore, each of these new training media can be used in many different ways with different job tasks to attain different training objectives. The new media are not effective methods in themselves. They are only effective for certain tasks, and then only when used with the proper technique.

Today's training program still involves a large number of administrative considerations (Figure 2), but it is becoming increasingly more dependent upon the methodological considerations of media and technique. And the selection of efficient methods requires some knowledge of their underlying psychological principles.

During this period we will consider some of the basic psychological principles upon which educational training media and techniques are based. The purpose of this consideration is to provide a background for understanding and using the training media and training techniques that make up the more applied training methods that we will discuss later.

Learning and Performance

The central process of training and education is learning. When we develop and conduct a training program we do so with the expectation that the experience in the training situation will change the behavior of the trainee in some way, and the particular way in which we wish to change behavior is through the learning of new skills and knowledges. We might begin, then, by considering what learning is and what it is not. What are the characteristics of learning?

Learning results in some kind of change in behavior and this change is brought about through practice. Practice alone provides the change in behavior. This characteristic may rule out changes that are due to conditions that we often consider as "causes" of learning—conditions such as motivation. Many times we act as though motivation were a primary cause of learning. We blame poor learning on low motivation and attribute good learning to high motivation. This is not strictly true. Motivation is one of the conditions

Table 1

Selection Criteria for Training

Selection Criteria	Percentage of Technical Training Personnel Who Mentioned These Criteria
1. TIME TO PRODUCE	100
2. NO. OF STUDENTS TAUGHT	83
3. EFFECTIVENESS OF TEACHING MOTOR SKILLS	75
4. EFFECTIVENESS OF TEACHING THEORY	75
5. AMOUNT OF DATA NEEDED TO PREPARE	75
6. COST TO TEACH	75
7. COST TO DEVELOP	75
8. FACILITIES NEEDED TO PRESENT	67
9. SPECIFIC OBJECTIVES	67
10. LEVEL OF STUDENT INTELLIGENCE	58
11. STUDENT KNOWLEDGE	58
12. Student Motivation	33
13. QUALITY OF SPECIALISTS TO DEVELOP MATERIAL	33
14. EASE OF EVALUATING STUDENTS	25
15. FACILITIES NEEDED TO PREPARE	25
16. EASE OF ADMINISTRATION	17
17. COMPLEXITY OF THE TRAINING MATERIAL	17
18. FLEXIBILITY	17
19. NO. OF INSTRUCTORS TO INSTRUCT	17
20. NO. OF INSTRUCTORS TO DEVELOP	17
21. Student Reinforcement	17
22. Student Participation	17
*23. Realism	8
*24. Transfer of Training	8
25. MANEUVERABILITY	8
26. Variety of psychological/learning processes	8
27. Student feedback	0
28. Retention	0
29. Student-paced	0
30. No. of senses stimulated	0
31. LENGTH OF COURSE	0
*32. Stimulation of the operational environment	0
33. EASE OF PRESENTATION	0
34. Competition	0

CAPITALS = management-centered items
Lower case = student-centered items
* = equally student- and management-centered items

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Components in a Training Program

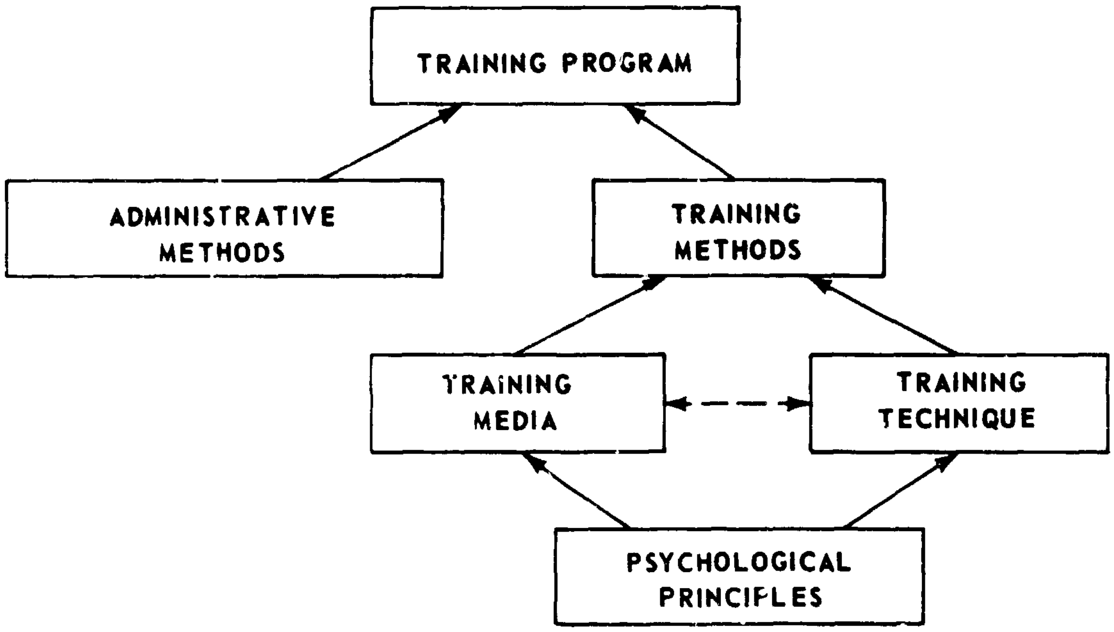

Figure 2

under which practice takes place. Training techniques which vary motivation may provide practice conditions that aid learning. But motivation in itself does not lead to learning. Only practice leads to a learned change in behavior. This difference between the conditions of practice and practice itself may be clearer when we consider the next characteristic of learning.

Learning is a change in behavior that is relatively permanent. We may perform some act until we become very proficient in it, and then not perform this act for a fairly long period. Yet when we are again called upon to perform the act, we do so with relatively little loss in proficiency. Practice alone has resulted in a fairly permanent change in our behavior. For example, one may learn to ride a bicycle, and then not ride for years. But when the individual tries riding again, he is quite proficient compared to the level at which he originally started to learn, and after only a few practice trials is back to his previous level of proficiency.

In contrast, what we have called the conditions of learning may not result in permanent changes of behavior. Part of the final performance on the bicycle may have been due to high motivation while learning. If this level of motivation is not present when relearning to ride, it will not show up in the behavior. Or, the individual may have practiced so long that he became tired and his performance began to deteriorate, but after a short rest this fatigue disappears and he will be performing at a high level again. The techniques that control the conditions of motivation, such as fatigue, directly affect performance, then, but do not directly affect learning. The method by which we have shown this difference, by reference to performance, suggests the final characteristic of learning.

Learning is not a physical thing that we can observe directly. It is something that occurs inside the trainee, so we must be content to infer learning from some other process. This process is performance. But we have already noted that performance reflects a large number of changes, only a few of which are those permanent changes we call

learning. If we are to assess training on the basis of the amount of learning it provides, and if we can only make this assessment on the basis of measurable performance, what are the aspects of performance with which we must be concerned in training?

(1) What performance events can we observe and measure? If performance is an overt act by the trainee, what are the observable events of this act? We can define three principal events—the stimulus, the response, and the consequence of response which we term feedback.

What precedes an act we call a *stimulus*? Stimuli can be very simple: a command, a light, or a tone. Or stimuli can be very complex: a map, a concept, a sequence of events occurring to the pilot from the expanse of terrain in front of a landing aircraft. All of these stimulus events occur external to the trainee and can be measured in terms of some physical or psychological dimension. But stimuli can also be events occurring internal to the trainee and measurable in physiological or psychological dimensions: the glandular reactions of fear, the proprioceptive cues of muscle movement, the feelings of despair. We are not always aware of these stimuli—as, for example, the internal stimuli produced by your heartbeat or breathing ten minutes ago, or the small movement of the man sitting next to you. But some such stimulation occurs before every human response and that stimulation that reliably occurs before a particular response later becomes a signal for that response to occur. Stimuli, then, are the signals in what we call performance.

The performance itself is the *response*. It, too, can be simple or complex. We can measure it in many ways: presence or absence, accuracy, time, intensity, and so forth. In most cases, the trainee's response is rather easily defined and measured: answering a question correctly or incorrectly, turning to the right within a given time after command and with the correct carriage, locating a malfunction within the time specified and following the prescribed procedure, adjusting the radio to the correct and exact frequency, or detecting a target that appears in the field of view.

As you no doubt noticed from our discussion of stimulus, a response may also produce the stimulus for another response. Simply, a startled response to a loud noise can produce glandular secretions that become the stimulus for tensing, running, or becoming more alert. In the same way, the proprioceptive cues from pushing a button in response to a red light may be the stimuli for next turning a knob. This chain of S-R-S-R will be important to some of our later considerations of training—particularly those dealing with the learning of procedures.

Finally, each response has some consequence which we call *feedback*. Feedback may be a natural consequence of the act, or it may be provided as a supplement by the instructor. For example, correctly tracking a target and pushing the firing button may result in the target blowing up if a projectile is fired. If a projectile cannot be fired, the same act may result in the instructor saying "hit." Feedback can provide one or all of three things: (a) It can reward or punish a particular act—"very good shot"; (b) it can tell the trainee which acts to select and which to drop—"your initial movement was slow and jerky, but your final track was fast and smooth"; (c) it can provide motivation—"you are doing very well."

From these three observable events, then, we can consider the curve of performance and the management functions that are suggested by this curve.

(2) "What is the performance curve like?" If we were to measure the performance of a trainee as he attains some degree of new knowledge or acquires a new skill, we would obtain an S-shaped curve as shown in Figure 3.

During the first stage, there would appear to be a great deal of confusion. The trainee would make a large number of errors, or be very slow in responding. During this period the trainee is learning the gross characteristics of his task—what stimuli he is

Hypothetical Performance Curve

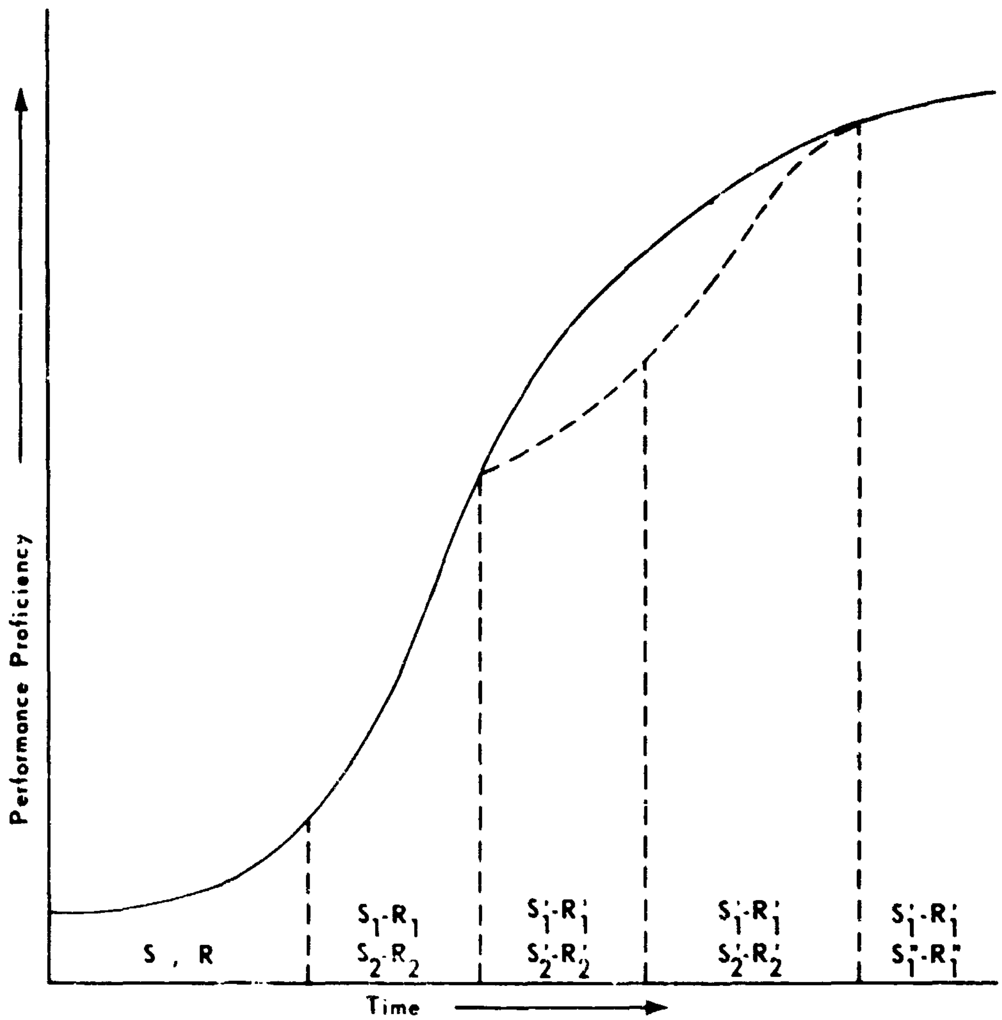

Figure 3

to respond to and what responses he is to make. We might refer to this as the stimulus learning and response learning stage.

After this initial period, as the trainee continues to practice, the quality, timing, and accuracy of his performance will begin to increase rapidly. During this period, the trainee will be learning to make finer discriminations within the range of stimuli and responses that are pertinent to the task and correctly pair slight differences in response to subtler changes in the stimuli.

After more training time has elapsed, some curves may show a temporary leveling-off period a plateau (dotted portion of curve, Figure 3). With respect to learning, such a plateau may indicate that the trainee has reached a temporary limit in the amount of task information he can process. Thus, he may stop to code the material he has already learned into forms that are simpler and better organized before he proceeds to process the remainder of the task. Learning is occurring, but it is not being reflected in the performance measure we are obtaining.

Finally, performance begins to improve again until it reaches an upper level an asymptote. This final level is dictated by a number of factors, such as the

physiological limits of the trainee or the engineering capabilities of the equipment. Beyond this point, the performance curve no longer increases, but the trainee may continue to improve in other ways. Performance may become almost automatic so that he can concurrently carry on other tasks. Or he may begin to modify his method of performing the task so that he can decrease the amount of work or fatigue involved.

(3) What does performance curve imply in terms of the functions the training manager must perform? In considering this hypothetical performance curve, then, we may note that different types of learning are occurring at different stages in the process, even though all types may not be directly reflected by changes in the curve. In actual practice, a particular performance curve may differ somewhat from this hypothetical curve. The trainees may enter the training situation with previous training and experience that would allow them to start at some advanced stage in the curve. Different tasks may contain different amounts of material at each stage, as well as differing difficulty levels of the material. Different trainees may vary in their abilities to learn the material at each stage, and different methods of presenting each stage may be more or less effective. The actual performance curve will vary greatly, then, in form, in the duration of each stage, and in the rate of change during each stage. The factors that influence this variation dictate some of the more psychological functions of the training manager. To get a better idea of these functions, let us look at some actual performance curves.

Baker *et al.* (2) obtained performance curves for different Armor skills as a function of training time, method, and trainee ability level (Figure 4). In each of these graphs, there are three curves—each representing performance after different training periods of an experimental course. The three curves are for high, average, and low trainee ability. In the same manner, the three points represent performance of the same ability groups after the regularly scheduled training time in a standard course. By comparing these curves, we can demonstrate three major functions that the training manager should be performing.

The two graphs in the first column show that trainees may enter each task with applicable knowledges and skills which place them at different stages in the performance curve. For "Turret Familiarization" this entering knowledge is practically nil, and training begins in the first stage of the curve. In comparison, "Actions Against Enemy Tanks and Antitank Weapons" begins at a later stage in the curve with trainees bringing a fair amount of relevant knowledge to the program. One function of the training manager, then, is to match the initial stage of instruction with the relevant level of trainee input ability.

From the graphs in the second and third columns, we see that task learning may progress at different rates over training time and may level off at different stages of proficiency. "Organization and Mission of Tank Units" grows rapidly for the first one-half hour, and then levels off over the remaining three hours tested. In contrast, "Direct-Fire Sights" continues to increase significantly over the entire 12-hour training period. "Starting and Stopping Procedures" reach over 80% perfect performance after only six hours of training, while "Crew Maintenance" is still at 55% after 24 hours of training. Also, by noting the course of the curve, at the point showing the time scheduled for present training, we can see that we are now overtraining on some tasks and undertraining on other tasks. In addition, these curves indicate that the level of performance attainable in any training period may vary with trainee ability, although this is not always true. "Starting and Stopping Procedures" shows no effect of trainee ability on performance, while "Organization and Mission of Tank Units" shows fairly large ability differences.

A second function of the training manager, then, is to set performance standards for each unit of training and to continuously monitor training to ensure

Trainee Performance Curves

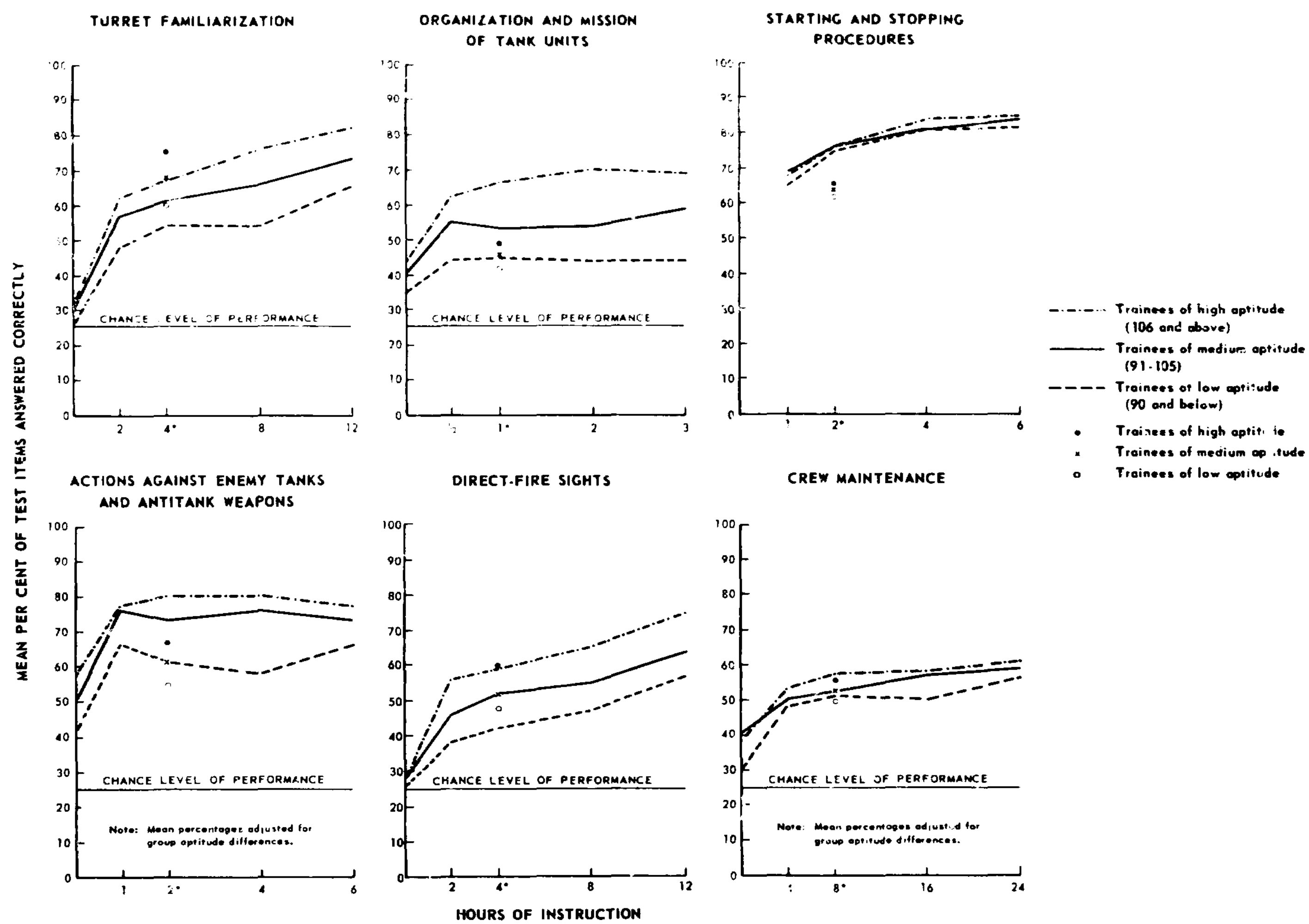

Figure 4

efficient apportionment of training time—always cognizant of possible changes in trainee ability.

Finally, from these graphs we can see some of the effects of different training methods with the same tasks. For most tasks, the experimental training method resulted in higher proficiency than did the standard method. However, for "Turret Familiarization," the standard method was best. The third function of the training manager, then, is to select the most effective training method for the task to be trained, to continuously up-grade this method as new training knowledge becomes available, but to test each modification against a cost-effectiveness criterion.

Baker's performance curves have indicated three major functions that should be performed by the training manager. First, matching the initial level of course content with the relevant trainee input characteristics—*a determination of trainee readiness*. Second, stating performance standards and objectives for each stage of training, and continued testing to ensure that standards are being attained—*production control*. And third, *an informed and validated selection of training methods.*

At the beginning of this paper, we noted a study that showed that each of these functions is now being slighted in the development of most training programs. By comparing actual performance curves, we have obtained some idea of the tremendous cost in resulting wasted training time and facilities and poorly trained soldiers. With just the six tasks presented, we can see that poor management has resulted in wasted training time for half of the tasks while at the same time, possibly, undertraining for the other half of the tasks. Such costly mismanagement can be avoided only if the training manager makes full use of all three of his functions. In this course we are emphasizing the selection of training methods only because it seems to be the most ignored and least understood of the three functions, but trainee readiness and production control are equally important and we might consider each of them briefly.

Trainee Readiness

"What is the baseline of information and skill which we need to start a particular training segment?" Or, "Is the trainee prepared for the training situation?" We often simply assume that the trainee has been through an appropriate selection process or has had previous training and experience and so is equipped with the basic capabilities for the course. But this is not always true.

Our hypothetical performance curve indicated that the underlying learning is a building process. To begin training at one of the later stages in this process assumes that the trainee already possesses the prior skills. If this is not true, the trainee will have nothing to build on and the instruction will just go over his head. The rationalization that the trainee is not "motivated" enough to learn any particular subject matter should receive careful study. In many cases, it hides the real problem—that the trainee was not prepared for that subject. On the other hand, if training begins too early in the process the trainee will be receiving information he already possesses. The result will be wasted training time and a possible loss of motivation that will permeate the entire program.

The design of any training medium, then, must be influenced by the initial performance level of the trainees, and it is the training manager's responsiblity to relate the initial trainee-task characteristics. While this is an obvious requirement, it is overlooked surprisingly often. Let's look at a few examples to see where this need applies.

First, the need is apparent in *the statement of course prerequisites.* A recent New Equipment Training Program for key instructor personnel in operational and organizational turret maintenance had as a stated prerequisite, "a background of basic optical theory and electronics." It is obvious that this prerequisite cannot be met within this level of employee. Accepting this prerequisite assumed a false initial trainee ability level

and opened the door for great quantities of course material for which the trainee had no basis for understanding. As a result, information that was important to the trainee, and was within his grasp, was hidden under a wealth of confusing technical data. This same assumption seems to continue with more recent proposals to provide this same group with instructional blocks on such topics as "Binary Number Systems," "Computer Theories," and "Laser Optics Theory."

Second, the need is obvious in *the scheduling of class periods* within many programs. The standard example is the electronics course situation in which the trainees are supposedly learning to check resistors with an ohmmeter before they have attained the required proficiency in reading resistor color codes or setting and reading the ohmmeter. We could find a parallel to this situation in the scheduling for most training programs.

And, finally, the need is obvious in the lack of change that is evident in most *input assumptions*, although trainee input has obviously changed radically. Several years ago a training center was experiencing difficulty in teaching the mil formula. A closer look at the input characteristics of the trainees indicated that a large number could not work with fractions or formulas. The course was based on previous trainee input, and assumed that these skills were available to the entering trainee. Originally, this assumption had been true but trainee input had changed and the assumption was no longer valid. This problem is present in many existing training programs, and will increase with the increase in acceptance of more lower-aptitude personnel into the Army.

One clear implication of these examples is that we must plan for the students' capabilities before and during the training program—not just at the completion of training. We must state where the student will begin in the same concise terms that we use to state where he is going. What are the specific prerequisites for learning, and what is the trainee able to learn next? If the course is to be effective, the training manager must assume responsibility for:

(1) Determining the relevant trainee characteristics for each section of a course and stating these characteristics as course prerequisites. This pertains not only to the initial skills and knowledges of the trainee, but also to the level of attainment in each enabling skill that will permit him to successfully enter the next level.

(2) Study proposed course material and scheduling to ensure that the initial level of the presentation matches the level of trainee ability specified by the prerequisites.

(3) Continue to monitor both changes in trainee input and course modifications.

Production Control

It is obvious that if the training manager is to monitor the learning process, he must maintain some form of production control. In equipment production, we establish measurable standards for each subsystem, similar to our training objectives. But we also establish standards for each part in that subsystem, and we provide for continuing inspection of parts during production to ensure that they will meet the final requirements. The same method of part-course standards and continuing periodic inspection is applicable and necessary to the training program.

Performance curves, such as those obtained by Baker, are available for some of the present courses. These curves would allow us to set standards. However, such curves have never been obtained for most courses and objective standards are hardly ever stated. In addition, when curves are available they are usually outdated. Subtle changes in instruction or trainee input can greatly affect the presentation. Even the introduction of a simple training aid to demonstrate a principle may greatly shorten the time required for the trainee to master that principle.

The effects of the present situation are easy to see in Baker's data: Too much training time for some tasks and too little for others, and whole segments of instruction

losing their effectiveness through well-meaning modification without the training manager becoming aware of the change.

In order to maintain close liaison with his curriculum, then, the training manager must establish some system of continuous within-course inspection. This is best done by determining the standards necessary for each course segment and instituting a program of periodic objective testing within the course.

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Training Devices

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In today's Army, training aids and devices have become an important adjunct to almost every training program. The current U.S. inventory of training aids is valued at 50 million dollars, and millions of dollars more are on the drawing board. Their development ranges from such simple aids as blackboards, films, and operable transparencies to complex maneuver simulators that provide the inputs and outputs for controlling whole armies. Their value is reflected in decreased training time, increased training effectiveness, less reliance on actual equipment and environments, and their ability to provide simulated situations that would not otherwise be available in the training facility. These values have led to a tremendous demand for devices of all kinds.

But training aids are not automatically cure-alls. Often demand for aids—especially in periods of mobilization—has been so uncritical that it has resulted in urgent development and production without reference to expense and without determination of actual training value. The need for training aids and devices is strikingly obvious, but the results of uncritical, unevaluated use of devices are even more obvious. For example, during World War II we developed, but could not test, a Dead Reckoning Trainer. It consisted of 48 individual booths equipped realistically with navigation instruments connected to a master control unit. It cost a lot of money and required a lot of training support. Yet a postwar evaluation showed that it was no more effective than a simple blackboard presentation. We also used a device to train antiaircraft gunners and then later found that it actually trained men to miss the target.

But we don't have to go all the way back to World War II for examples. Even a cursory examination of present device inventories would show that major deficiencies still exist:

(1) Firing and Ranging Weapons Simulators purchased for appromately $1,000 apiece after a $65,000 development cycle. Placed on the shelf for months because *no training program had been developed for their use.*

(2) Tank Turret Trainers costing over $40,000 to develop and $6,000 apiece to buy. Stored against the wall because they are *not the type* that can be used with the class facilities and training requirements we now have.

(3) A Davy Crockett Trainer with an estimated prototype cost of $10,000. Immediately placed in salvage because it was *too fragile for use.*

(4) Vehicle Driver Trainers costing over $15,000 apiece, which have a reduced training effectiveness because the *device concept was radically altered by the developer.*

(5) An expensive Range Finder Trainer that was tested and found to have *no training value.* It is used to train burst-on-target—a task that is trained just as well with a $12 mock-up.

These are but a few examples that underscore the need for better management of the development and utilization of training aids and devices. They also serve to illustrate some of the requirements that should guide such management:

(1) A training device does not train, the training program trains. Therefore, the device must be developed only on the basis of a specific need in the program. As a part of the program, the device represents some aspect of the job. To do so for training, it must provide the psychological parameters of the job, not just the physical engineering parameters.

(2) The type of device selected must not only be best suited for the particular task for which the training is being conducted, but it must also be a type that can be supported by the training facility. That is, it must be flexible enough to be used in all anticipated training situations (class size, classrooms, job orientation), it must be rugged enough to withstand handling and abuse, and it must have operating tolerances that the instructor can reliably meet and that available maintenance personnel can support.

(3) Device development must be closely monitored by the training manager to ensure that the training concept is maintained and is fulfilled in a manner that can be supported when considering instructor, maintenance, and facility requirements.

(4) The training effectiveness and cost effectiveness of the final device must be objectively evaluated by engineering test, training test, and cost effectiveness criteria.

The selection of effective training devices, then, is a process of management functions. It is a process that requires continuing attention by the training manager. The examples illustrate the results of neglecting any one of these functions, so we shall consider each of them and the major requirements for fulfilling them. Later, we shall apply this information to a common device problem: vehicle driver training.

The first function states that the device requirement results from a specific program need. Somewhere in the writing of the program, we have decided that the material can be presented most effectively by the use of some kind of device. The type of device, its characteristics, and the way it will be used are dictated by the program. The program is not written around a particular device we have obtained. Rather, the device is obtained to fill a need in a program that has already been written.

At this point in the development of the training program, management's job is: to consider the kinds of devices that are available to fill the need, and the characteristics they should provide for training; to order the device; to monitor its development; and, finally, to test the effectiveness of the final product.

Types and Characteristics of Devices

Our first consideration, and the most difficult one, is with the types of devices available and the characteristics they can provide.

Normally, training is conducted in three successive stages (Folley, 1): presenting fundamental information, demonstrating principles and procedures, and practicing job tasks. For each of these stages, different types of devices have been developed to present the particular aspect of the knowledge or skill that is vital to that stage. Parker and Downs (2) have catalogued the various types of devices, their use in each of the three stages of training, their relative costs, and some of their advantages and disadvantages. This publication is a worthwhile "cookbook" for reference by any manager who is considering an investment in training devices.

We will not attempt to go through such a cataloguing in this presentation. Rather, we will consider ome of the principles that underlie the categories. It should then be possible to extend this analysis to any device requirement.

(1) **Information.** The first stage in the training process is the information stage. During this stage the trainee is told about the task to be learned—how it fits into his total job and into the overall system. He is also told, in general terms, what will be required of him. He learns the technical vocabulary and information that will be required to perform the task, and he learns how to identify and locate objects, either physically or by the use of words and symbols. This latter operation, words and symbols, includes much of what we mean by "facts."

One kind of training device, then, is used to present information. The class of devices for information presentation includes most of what we refer to as passive audio-visual aids: blackboards, charts and graphs, slides, and films. These aids allow little student participation other than observing and listening. On the other hand, this class also

includes trainee response devices such as workbooks and self-scoring test forms. These two kinds of aids are "tools" placed in the hands of the instructor to supplement his activities.

Overlapping these are the auto-instructional devices which both serve an information-presenting function and afford a means for the trainee to make relevant responses in relation to the material presented. Many of the "programed learning" devices have the additional advantage of allowing the trainee to proceed at his own rate without the need for active intervention by the teacher. These devices, then, replace rather than supplement the normal activities of an instructor.

Here we might reiterate two important precautions that are often overlooked in the utilization of information-presenting devices. First, these aids are most effective with low ability groups. High ability groups seem to be able to learn equally well with any type of presentation. But low ability groups are usually not as experienced in attending to oral lecture presentations, and pulling out the important items of the presentation; nor can they easily visualize objects and conditions from a verbal description. The aid does this for them by presenting the picture and highlighting the important aspects. But to do this, the aid must represent the ability level of these trainees. It must do so by following all of the principles of simplicity, repetition, slow progress, and so forth, that are applicable to low ability trainees. Too many of these aids, particularly films, seem to neglect these requirements.

Second, too many instructors assume that the aid is independent of the program. They schedule films for rainy days or *hang-over* mornings without regard to their proper place in the instructional sequence. Also, in many instances, instructors use these aids without any adequately prepared instructional introduction or followup. As a result, the aid may relieve otherwise monotonous instruction and it may add a degree of interest to the subject, but the specific teaching effects of the aid are largely lost.

The effective and appropriate use of informational aids can result in more learning in less time, and in better retention of what is learned. But this is true only when the instructional aid is closely related to trainee ability and to the context of the instruction. The aid in itself does not train anything.

(2) Demonstration. During the second stage of training, the principles and procedures underlying the task are shown to the trainees. A second kind of training device, then, is used for demonstration.

One use of a demonstrator is to show principles in pictorial form. This may provide better or quicker *understanding* of the principle. It may also help the trainee to understand the cause and effect implications of the relationship. Or it may help him relate several component factors that may be combining to produce a common effect.

Another use of demonstrators is to present the *procedures* that are necessary to the task by performing them for the trainee. Here the trainee does not perform, he merely observes. These aids are used when the trainee must know how to carry out a set of operations that must follow a fixed sequence, and they are also used to present the arbitrary rules of contingent procedures, such as, "If this is observed, do thus and so."

The primary kinds of demonstrators are cutaways of the actual hardware, operating mock-ups and models, and animated panels. Usually, as we move farther from the actual hardware we are able to decrease complexity and cost, but this is usually done at the expense of realism. The extent to which this is desirable depends upon the specific function the trainer is to provide. Miller (3) has listed three major demonstrator functions that we should consider: show how inputs affect outputs, generalize information, and relate disconnected areas.

a. Show How Inputs Affect Outputs

Simplify Concepts. The demonstrator may schematize the linkages between complex inputs and outputs, thereby simplifying the idea of how a complex

piece of hardware works. Its advantage over a two-dimensional aid is that the trainee does not have to imagine the dynamic process involved but can actually observe it. Thus, the push-pull forces of a hydraulic system can be represented without showing the detailed components of actuators or the electrical circuitry associated with servo valves.

Eliminate Irrelevant Details. The demonstrator can simplify schematic relationships by downgrading visual realism which may distract the trainee or clutter his recall.

Dramatize Outputs. The demonstrator can present outputs in realistic terms, that is, it can show the target as a tank rather than a partially concealed blob. This literal representation of the effect of an output may help arouse trainee interest and, by being concrete, aid him in remembering the concept in later real operations. This function is the opposite of the simplification function and should be limited to adding realism to outputs. Care should also be taken to ensure that the output does not become so vivid that it obscures the principle the trainee is supposed to be learning.

Dramatize Differences. The demonstrator can emphasize and distort the differences between principles, hardware, or procedures. It may decrease the scale in time and distance in comparisons so that the trainee does not have to retain ideas long enough to become confused or forget what came in what order.

Provide Functional Level. The demonstrator can present information at the specific level at which the trainee will operate. The level of understanding presented can be minimal with respect to the complexity and number of variables presented. Keeping ideas at the level of ability required by the job.

b. Generalize Information

The demonstrator may simplify the understanding of different objects by showing how they are related to each other by common principles. In this way we might emphasize the differences between the operations of two kinds of weapon systems (conventional and missile), making them more understandable by demonstrating how common changes affect both. This may reduce interference of habits in firing the two systems, and may also help to integrate the specific responses within each task.

c. Relate Areas

The demonstrator can show the relationship of areas usually far removed from each other. It can show the effect of the shift lever on the operation of the transmission, the relationships between several course topics, or how the jobs of the operator and mechanic affect machine outputs.

All of these functions are provided in varying amounts in the different kinds of trainers. The problem in selecting the particular demonstrator to use is one of balancing *relevance* and *simplicity*. In this respect, one can easily be carried away with the beauty and intricacies of the trainer and completely forget the trainee. Some animated panels become so loaded with color codes and gadgets that the principles are completely lost in the beauty of the panel's operation. These devices soon become toys rather than trainers, but when they are properly designed and used demonstrators can greatly shorten training time and cost.

3. **Practice.** During the final stage in formal training, the trainee practices the task by actually performing it himself. He learns to: (a) integrate the cues that were presented during the initial information stage, (b) choose a course of action by applying the principles and rules learned during the demonstration stage, and (c) integrate skilled perceptual-motor acts to a high level of proficiency. These acts may be as simple as using hand tools or as complex as manipulating the controls of an airplane.

It should be obvious that the later phases of this practice continue through most of the man's career. It will be used to maintain proficiency later on the job and as

a transition to evolutionary modifications of tactics and equipment. So trainers used during this stage of formal training are often used also by the field units. The training manager must keep in mind the requirements and capabilities of both the schools and the field units when he selects, develops, and evaluates the devices for this stage.

During this stage we see all of the types of learning we referred to at the beginning of the course. Stimulus learning as the trainee begins to integrate relevant cues; response learning of simple motor acts; multiple discrimination; chaining; and, finally, the more compelx use of problem solving and rule application as he attempts to make decisions or perfor... the total job task. Trainers can be used to develop any one part or a combination of parts of this task. Or they can be used to develop the total task. Furthermore, the trainer can present the hardware components of the task in relative isolation from the expected job environment, or within a completely simulated context.

One of the training manager's decisions, then, is how much of the job to include in the trainer. Should we train on a series of devices, each providing more of the final job requirements? Or should we develop only one trainer which encompasses all of the requirements of the final job? For example, should we train tank gunnery by using a series of trainers of increasing complexity—giving the gunner procedural training on a simple device; then tracking manipulations with only controls, sight, and a simulated target; then crew training in a simulated turret and finally, the complete system training in the actual vehicle? Or should we use only one trainer—the final systems device followed by the actual vehicle? The answer obviously depends on a number of task and facility factors. Is the total task too complex to be learned as a unit? Is the length of training required for any part of the task (e.g., gunner tracking) and the number of students that must be trained too great to justify tying up a complete crew trainer? Or is the cost of the complete trainer too great to buy the numbers necessary to accomplish any part of the task in the time allotted for training?

We can see the necessity of tying the device requirement closely to the training program. The program will state the complexity of task that can be trained in any instructional unit. At the same time, the cost and complexity of the device required will partially dictate what these instructional units can encompass.

Environmental Simulation

Perhaps a more involved question that faces us is: "What degree of environmental simulation do we need?" With the ever-increasing complexity of our equipment and jobs, environmental simulation is becoming an increasingly important concept in Army training. Several factors are radically increasing the demand for including some training that provides almost total job simulation:

(1) Our weaponry is reaching a state of destructiveness and cost that prohibits actual firing for training or for proficiency maintenance on the job.

(2) The need for land is increasing but the amount of available land remains the same, or decreases. Increased weapon ranges and tactical concepts for the atomic battlefield are beginning to pinch available training areas.

(3) The cost of large-scale exercises to test concepts and train for every level of unit readiness has become astronomical.

Simulation, then, is a concept that will become increasingly important, but it is a concept that is fraught with inconsistent meanings. For one thing, total simulation of an operational job would require an exact identity of the job itself on the operational equipment. But the training device is hardly ever this complete. Unless the device is the actual operational equipment used under operational conditions, some of the hardware

and environmental variables will be modified, or left out completely. Many people still talk about a simulator as if it were an all or nothing matter, but the truth is that a simulator is a matter of selection and degree. Some variables are represented and some are not. Those that are represented may be matched exactly to the job conditions or they may be presented to a much lesser degree.

A feature of all simulation, then, is the deliberate omission of some aspects of the real situation and concentration on those aspects that are thought to be most important to system success. The training manager must decide what aspects are to be included in the trainer, and to what degree.

This matter of aspects or variables of the situation that are to be included in the training device presents another common inconsistency in the term simulation The engineer uses the term to express the duplication of physical and functional characteristics of equipment within very close engineering tolerances. But the problem of physically copying the equipment is not the same as the training problem. *The training problem is to provide stimuli so that the responses learned to them will transfer to the job with little or no loss.* When we are successful and transfer does occur after training, we can speak of the synthetic training conditions we have provided as psychological simulation. But this psychological simulation may have been much different than the engineering simulation. So the development of training realism depends on two considerations: the degree of engineering simulation required, and the degree of psychological simulation required. Some tasks require a high degree of engineering simulation but many tasks can be learned and transferred to the job with practically no physical or functional realism.

The selection of variables that should be included in the trainer is thus based on psychological considerations of training effectiveness and transfer to the job, *not on physical realism.* Unfortunately, we do not know all of the parameters of psychological simulation, but there are some guidelines we can follow.

First, with respect to engineering simulation, we know there are usually increases in training value with increased physical realism. But this is only true up to a point as shown in Figure 1. Beyond this point, the gains in skill become uneconomical when we consider the increased cost of production and maintenance. We do not know exactly where this point lies, but we do know that the trainee is adaptable to differences between the training and operational environments that would shock most engineers. In the navigation example discussed earlier, we saw that the trainee could transfer navigational concepts from a blackboard to the operational environment without the need for physically duplicating all of the equipment configurations and inputs for his station.

As long as the trainee feels proficiency in the task, he can readily overcome rather wide changes in surroundings. This is particularly applicable with motor skills, less so with perceptual skills that require the anticipation of patterned changes in stimulation. For perceptual tasks we have to hold quite close to the environmental conditions of the job. But even here, if we stay within broad limits, we will be relatively effective. To help decide what level of physical realism we need, we should consider four factors: variations in hardware performance, variations in environmental factors, the psychological capabilities of the trainee, and the level of training. The first two are trainer input and the last two can be used as criteria for evaluating this input.

Briefly, *all hardware will show some variation* in output due to initial engineering tolerances, wear, or operating circumstances. Many of these variations can be obtained during engineering and service tests of the equipment. These variations affect task performance, and one function of training is to allow the trainee to learn to adjust to such variations. So we should build the training equipment to reflect no more accuracy than the actual hardware. (We are particularly remiss in this requirement with weapon systems. Trainers here seem to be built on the basis of what we would like to have t!

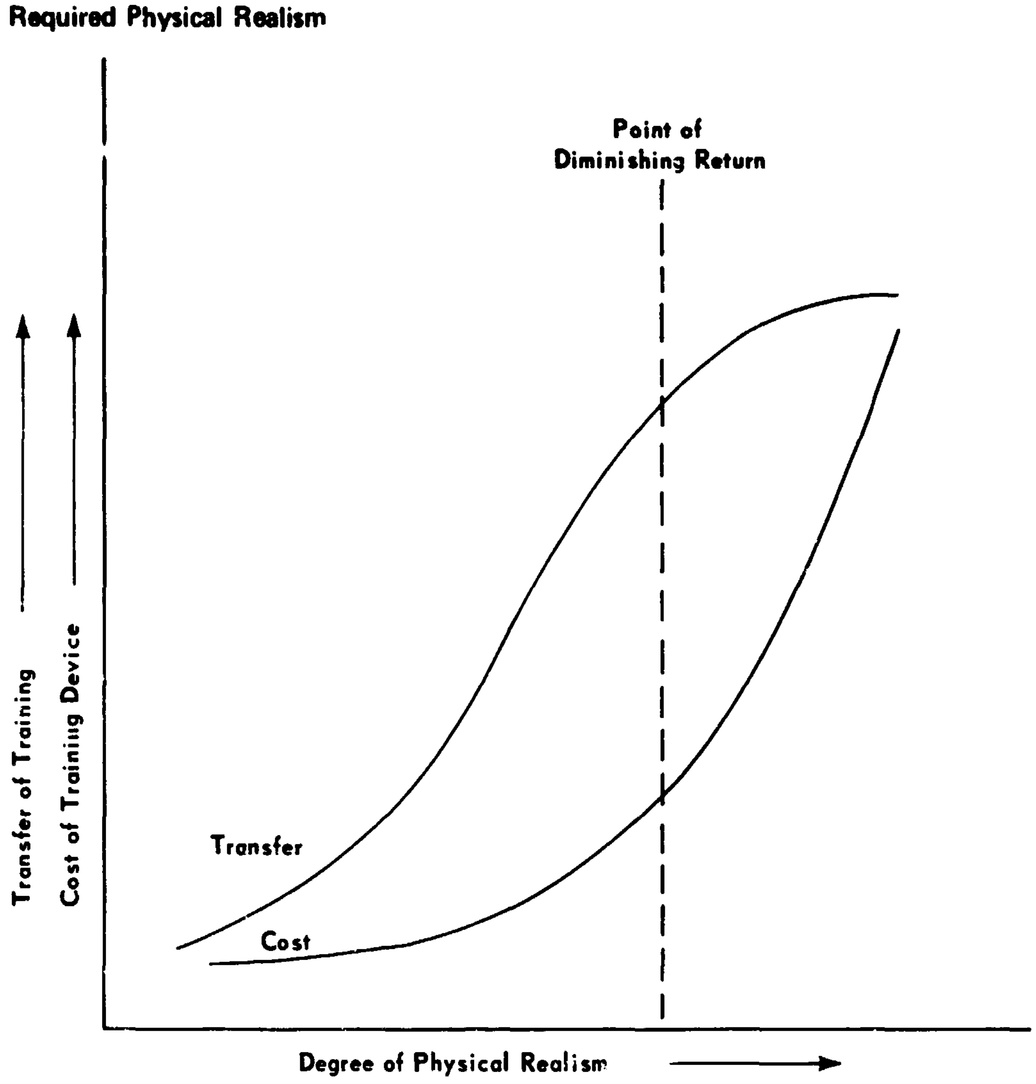

Figure 1

weapon do, the QMR phrases, rather than what we actually get. Many trained gunners have been totally surprised and frustrated at not knowing what to do when they first encountered the amount of lag we have in tank turret control systems, or the actual round-to-round variation in trajectory.)

This need to sample the known variation in hardware characteristics is equally true of the expected *variation in environmental factors*. What is the operator to respond to (targets, terrain, decision data, etc.)—and under what operating conditions (weather, time periods, irrelevant information, etc.)? The importance of providing practice which reflects the range of variety of both engineering and environmental parameters should receive careful consideration. The range of skill that results from the trainer program will tend to reflect the range of conditions provided.

But we must evaluate all of these data against the *known capabilities of the trainee* and the *level of training*. The human operator has limitations as to the stimuli he can discriminate, the number and complexity of signals he can process, the differences in pressure he can sense, and the speed with which he can anticipate and react to changes.

Because of these limitations, the trainee may respond in the same way to a number of hardware and environmental variations that are measurably different. The first economical retreat from physical realism can thus be made on the basis of human capability. On this basis, we may be able to greatly simplify the program requirements of the trainer.

Stage of Training for Simulator Use

A second simplification is usually possible when we consider the stage of training in which we intend to use the simulator. Usually, the early stages of training require much less physical realism than the last stages, just before transfer to the operational equipment. We can thus consider the feasibility of part-task training as a method of economizing. Simulator costs and complexity increase rapidly with increases in physical realism. And as cost increases, the number of simulators we can afford decreases just as rapidly. When we are faced with the requirement for training large numbers of men, the time/cost requirements for complex simulators usually become prohibitive. In these cases we may accomplish training more rapidly and efficiently if initial training is provided separately on components of the task or on degraded tasks.

Thus, in answer to the questions we posed earlier, we might train gunnery procedures, tracking, loading, or driving skills in a greatly impoverished environment during the intitial stages of the program; transferring to the final desired level of physical realism only during the final training periods.

This, then, has been a very sketchy review of the types of devices we can use and some of the major factors which affect their cost and efficiency. While we have not intended to be exhaustive in this review, hope it has still indicated the wide range of information that the training manager must have if he is to make valid decisions about device requirements. Much of this information will be in the nature of a "best guess" that will have to be checked after a prototype of the device is available, such as the amount of physical realism required. But we can still note quite a bit of information that should be rather firm by the time we are ready to request a device.

Requesting Device Development

First, there are a number of *Program Requirements* that dictate the type of device we need and what characteristics it must include. We must know exactly what the task we are trying to train involves and how it is to be included in the course. From this we can at least guess at the psychological parameters that must be included and the abilities the trainee will have when he begins to use the device. (In our tracking example we should know from the course description whether the trainee will have learned nomenclature, location of controls, and firing procedures before he reaches the device stage. Or will he have to learn all of this on the device itself?)

We should also know whether he will be a part of a large class or a small group. All of this information would suggest whether we need a fairly complete but open replica of the hardware, or just a partial duplicate with access mainly restricted to the instructor and the man in the gunner's station. From the task description we can also "guess at" what duties should be stressed because they will be particularly difficult; a long, complex, or dangerous procedure that we could stress by numbering or emphasizing control steps; several similar reticles that have important differences we could highlight; a stabilized sight that presents great initial tracking difficulties but which we could build up to with several steps of increasing difficulty. And, of course, we must know what degree of proficiency the trainee must attain. If it is a low level, we can omit many of the more costly variables that affect only peak performance.

Secondly, we must know how well we can *support* devices both during instruction and in later maintenance. Many times we find ourselves severely limited in what we

would like to have and the complexity that instructors, maintenance personnel, and facilities can support. If we restrict our thinking to what we would like to have, we end up with a device we cannot use.

And, finally, we have to consider the needs and capabilities of all installations that could use the device. Our tracking device may be fairly austere and still meet all of the needs of a school program, especially if more complex trainers are to be used later during OJT. But field units may not be able to support the more complex trainers even though they need some kind of trainer to maintain proficiency. By adding a few extra items to our device, we might most economically meet the needs of both the schools and the field units with a single device. On the other hand, our device might include all of the factors needed by the school and the units but require facilities that are only available at the school. By simplifying the facility requirements we might obtain a device that can be used.

These three aspects of the device must be considered by the training manager if he is to make a valid request, but they must also be stated in that request if he is to obtain a valid device. Let's consider the request itself and then see why these aspects must be included.

There are two major device development facilities available to the training manager. The first is the local Training Aids Center located at most major posts. It is usually financed through the regular post budget. In most cases it is limited to producing the simpler graphic training aids, lending standard items, and maintaining simple devices. The procedure for requesting the fabrication or loan of an aid is available from your local Training Aids Center in a brochure. They will also provide a catalog of the standard items they can handle or loan.

The second facility is the Army Participation Group at the Naval Training Devices Center in Orlando, Florida. This Group, as a part of the Army Materiel Command, builds and maintains most of our complex training devices. The procedure for requesting devices from this facility is given in AR 705-5 (4). Normally, these complex devices are developed as part of a major new equipment development program. A look at the AR shows what information we get from this program and what we are responsible for in the way of training devices.

First, it is noted that U.S. Continental Army Command is responsible "for training aids and devices of all types for both individual and unit training," and that this is accomplished through Combat Development Command, by coordination and review of two documents: the Qualitative Materiel Requirement (QMR) and the Small Development Requirement (SDR).

The outline of the QMR shows the format for Training Considerations and Training Devices. But at the equipment concept stage, when the QMR is written, these sections have to be fairly general. All we have is the equipment concept, our past experience with similar kinds of equipment, and what we suspect may be the job duties for this type of equipment.

As the equipment is developed and the actual hardware begins to emerge, we can begin to firm up the QMR estimates of the training requirements. We can see that most of this information will have to come from training aspects that are considered in equipment reports and during in-process reviews. In point of fact, then, CONARC is almost totally dependent upon AMC and CDC to ensure that these aspects are being considered. This is a major weakness of the present system. AMC is, of course, mainly interested in the hardware itself, and CDC is interested in how well that hardware will meet the anticipated tactical requirements. For both agencies, training is only a minor side-line consideration. But under the present directives, we must still assume that CONARC will obtain the relevant training information in enough detail and time to construct the training program and request the necessary devices. This time, according to

other directives, is 36 months before the equipment is fielded. At this point, CONARC must submit the SDRs.

Let us assume that we have the information needed and are ready to submit the SDR. What form should it take? The AR gives a rather general outline of what must be included. Here we can see what the training program had to be constructed before the device was requested. How else can we even estimate the quantity we will need, or the maintenance concept? Now that we know how the device requirements will be developed, we can see why we must include, under Purpose and Operational Characteristics, all of the information we have derived on Program Requirements, Support Requirements, and Utilization. The SDR will normally be written by the proponent school and staffed through CONARC to CDC to DA to the Training Device Center.

An engineer at the Naval Training Devices Center will write equipment specifications based mainly on what has been stated in the SDR, and an engineer at some private company will develop the device based on the specifications. Neither will have a training manager's knowledge of these requirements, nor will they be able to intuit them from a general statement. They will know what the hardware will be like, and can duplicate it, but they can only know what the training will require if you are specific in the SDR. Even what appear to be specific requirement statements to the man in the school can be changed so much in the writing of the specification and in the developing engineer's mind that it would be hard to recognize the final device.

For example, an SDR specified that the device be light enough to be carried by the tank crew. The device arrived and it could just be carried by a tank crew, but not safely to the top of the turret to which it had to be mounted and dismounted daily. An SDR specified that a tank turret trainer had to allow the instructor to critique the students. It allowed for this by providing an instructor's console with a powerful public address system. Fine for a platform lecture to a large class, but we use 15 or 20 of these devices in a single building with groups of six to eight trainees. Imagine what a class would be like with 15 to 20 public address systems going at the same time. Another SDR asked for a way to provide for target acquisition by the tank commander. The device did this with seven synchronized and overlapping motion picture projectors mounted on the outside of the cupola—hardly a device most of our instructors could operate or that we could maintain.

We can see, then, why we must be specific in the SDR statement of the training requirements. We must give the developer the benefit of all of the relevant information we have available at the time we request the device. But we must also monitor the development of that device.

Monitoring Device Development

The guidance for Section 2 of the SDR format, as found in AR 705-5, recognizes that some items will have to be "amplified at a later date," as more concrete information becomes available. It also recognizes that the development engineer is in the best position to select the actual hardware that can meet this requirement most effectively. So the format specifies that characteristics will be stated in "sufficient detail to serve as definite guidance for design without further description of characteristics." But as the designer selects the type of equipment that will best meet the requirement, he must still be guided by what the user can support. Many times all of these limitations cannot be anticipated in the request, but can be supplied by the training manager as needed. To supply this information, the training manager must be associated directly with each decision stage of the device development. When he isn't, the developer must rely on his own judgment and this judgment is apt to be faulty.

For example, we received a device that included a 35mm projector. This was the best hardware available to present certain information. How could the engineer know that

there was only one licensed 35mm projectionist on the post—a civilian at the local theater? Or that there were no qualified 35mm maintenance personnel on the post? On the other hand, how could the SDR writer have possibly stated all of these side limitations as guidance to the engineer? Another time we received a good trainer, but it had very high power requirements. It cost over $20,000 to rewire the building where the trainer was to be installed, and this power wasn't available at all for the trainers that were sent to Seventh Army. Again, how could the developing engineer have been expected to know this, or the SDR writer to anticipate it?

Obviously, then, the device must be developed with the full participation of the training manager at the requesting facility. There is no other way to even partially guarantee the usability of the final product.

But even this is only a partial guarantee—a guarantee that the device can be used in the program for which it was intended. But we still do not have any guarantee that, when it is included in that program, it will do what we wanted it to do or that it will do it more efficiently than some other method. Our original decision that this device could fill the program need better than some other kind of device, or better than the actual hardware, was an educated guess. Our specification of the characteristics the device should have was also a guess; guided by several principles, but still a guess. And we do this by testing the device, as a piece of hardware, in the same manner that we test any other piece of hardware.

Testing Device Effectiveness

When we develop a new tank we ask, and test, three questions. Is it durable and reliable enough for the mission it is to perform? Does it effectively satisfy the requirements of this mission? And, if so, does it do it cheaper than other methods that are available?

When we develop a training device we ask the same three questions. Is it durable and reliable enough for the training mission it is to perform? Does it effectively satisfy the requirements of our training mission, as those requirements are stated in the training objective? And, if it does, does it provide these requirements cheaper than other training methods we could have used?

If AMC and CDC are remiss in supplying CONARC with the information they need to develop an effective training program for new equipment, CONARC is equally remiss in testing the devices they have requested for that program. We test reliability and durability for a simple device by letting the instructor use it in the classroom. For major devices, AMC directs one of its Boards to include this test as part of its regular Service Test. But we hardly ever test the training or cost effectiveness of even the simple information and demonstration devices that we obtain locally. Of all the devices available, you won't find five that have ever been tested this way. We just get them and use them. And one result is that many of the devices we use are grossly ineffective or, as with the antiaircraft trainer, actually train the wrong thing. Another result is that we have a large number of devices that perform jobs that could be performed much cheaper in other ways, just as the complex and costly navigational trainer performed a job that could have been done by a simple, cheap blackboard. So every post now has literally hundreds of beautiful training aids and devices that are great eyewash for visiting dignitaries but are otherwise useless and actually cluttering up our training programs.

Each of the functions we gave for the training manager is now being performed in some manner with the exception of this final function which is almost totally neglected. As we have seen, we can—and must—improve the manager's performance of each of these functions; but without this final function all of our previous activities may be in vain.

I don't think there is ever a question of the need for testing devices; it is just easier not to do it. To test the training effectiveness of a device, we have to set up two

courses—one using the device and one without the device. To test the cost effectiveness of a device, we have to set up several courses using other possible methods of training. To do either, we have to have a good measure of performance at the end of training. And, as noted earlier, we do not usually have a training production control system that would give us the end-of-training tests we need so we have to develop them.

The methods for evaluating any part of the course will be given later. But let us stress here that these methods of evaluation must also be applied to a training device alone if we are to guarantee that we have chosen an effective course of action. None of the managers' functions will in itself guarantee that the devices we are developing are going to provide the training we need; but if we perform each function as well as we can, we will at least eliminate much of the needless device waste we find in our present training programs.

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Transfer of Training

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Transfer of training can be described this way: If learning one thing helps in learning a second thing, transfer of training is said to have occurred. It works in reverse, too, for if learning one thing makes it harder to learn a second thing, we speak of *negative* transfer of training.

There are many kinds of performance in which earlier learning may affect or transfer to later learning. Some examples are motor transfer, memory transfer, and transfer of principles. Laboratory studies provide illustrations of these kinds of transfer: *Motor transfer* was found in a study which showed that learning to assemble a switch made it easier to learn to assemble a simple loom (Woodward, 1). *Memory transfer* was not found in a study to which the ability to memorize was not increased by practice in memorizing either poetry, tables, or prose (Sleight, 2). Considerable *transfer effects from teaching principles* were found in an experiment in which the ability of boys to adjust their aim when shooting at targets submerged in water to varying depths was greatly increased by being first taught the principles of light refraction (Judd, 3).

Generally, it is hard to predict whether positive, negative, or no transfer will be obtained from the learning of one motor task to the learning of another, though there are some obvious cases such as the difficulties in clutching and shifting (negative transfer) often encountered when switching from a car with an automatic transmission to one with a stick shift. The recent trend toward standardizing the positions (Park, Reverse, Neutral, Low and Drive) on automatic transmission shift levers in cars is an effort to avoid difficulties which might be caused by negative transfer.

Unsystematic practice in memory generally does not improve the ability to memorize, but it has been shown that systematic instruction in techniques of memorizing will yield substantial improvement in memorizing performance (Woodrow, 4). Teaching principles will usually lead to substantial improvement (positive transfer) in any performances to which the principles are applicable.

What has all this to do with practical training situations? The answer is "Everything," because the whole purpose of training is to enable people to perform satisfactorily on the job. In other words, training *must* transfer to the job or the training is useless.

Also, within the sequence of training activities, there is the question of what kind of training activities and topics in the earlier phases of training will make the later phases easier and more efficient. This is a question of transfer, also, from the earlier phases of training to the later phases.

Transfer Considerations in Developing Training Courses

The basic factor in transfer of training is the degree of similarity or dissimilarity between training and the job, or between earlier and later learning. The more similarity, the more positive transfer should occur; the more dissimilarity or perhaps outright contradiction, the less the positive transfer and the more likely that negative transfer will occur.

Relevant Content. It may seem elementary that a course of training should include only material relevant to the performance requirements on the job being trained, but this

is sometimes not the case. For example, there may be a lot of material not needed in the on-the-job situation in courses designed to teach electronics technicians. Often the trainees will be filled full of electronics theory which might be necessary to design the equipment but is not needed to *maintain* the equipment—the usual job of electronics technicians.

The earlier sections of this course dealing with establishing performance requirements and deriving training objectives for a specific training program should have provided the concepts and methods needed to ensure that the content of the training is appropriate for the job being trained.

There are two other major areas in which transfer of training ideas are important. The first is in breaking down into appropriate blocks or sections the whole job, performance, or body of material to be learned and arranging these blocks or sections in a suitable sequence. The idea here is to teach first that which will help most in learning the later sections. The second area is that of transition or re-training, or cross-training in which a man is to be trained either in an altered version of the job he has been doing or in some different job in the same system. Negative transfer effects may be unavoidable in some cases. The point is to recognize situations in which this may occur and give special attention to them as may be needed.

Dividing and Sequencing Material. In dividing the whole job or body of material to be learned into appropriate blocks or sections and ordering these in some sequence, several principles may be utilized: natural sequence, simple-to-complex, performance analysis, and probably the most important and fruitful principle, meaningfulness.

If the job or performance has a natural or specified sequence, such as a set of maintenance or prefiring checks often has, it is probably a good idea to teach the material in this order, unless some serious difficulty is introduced by so doing.

An example might be found in training personnel for the maintenance of guided missile equipment in which there are two distinct areas (battery control, and launching areas) in a battery, separated by some distance. Many of the checks in each area can be performed independently of the other area, but some require cooperation. The checks for each area have a specified order in which they are normally done, but most of the training is done separately for personnel of the two areas. So the checks are taught in the specified order for both areas, with deviation from this order only to teach the checks requiring cooperation between the two areas at certain specified times when it is arranged that the two training sections involved shall teach cooperatively.

Most jobs or bodies of material to be learned can be arranged in a simple-to-complex order, to a considerable extent. This is usually a natural and suitable order in which to teach the material. One reason that this order of presentation is a good one is that success in learning the simpler material in the earlier stages of training helps students to be better motivated in learning the more difficult, later material.

In the section of this course on establishing performance requirements, methods were presented for specifying tasks and task elements, and for identifying skill and knowledge requirements. If these stages of the whole process of constructing a course of training have been well done, their products will be of tremendous help in developing the training program. The tasks specified in these stages should usually be quite suitable as sections or blocks of the training program. If the analyses involved in specifying performance requirements have been well done, the tasks specified should have a unity or integrity which makes them natural elements or sections of the training program. Transfer to the final total performance should be good.

Time Sharing and Interaction. There are a couple of cautions, however. If there is time-sharing between two tasks, they should probably be combined in training—certainly in the later stages of training if they have been separated in earlier stages. An example might be techniques of aerial observation and piloting an airplane or helicopter. Unless

there is a separate observer. the pilot must do both, and the integration of the two must be accomplished in training. If they were trained separately, a period of lowered efficiency and possibly outright danger would probably occur when the trainee had to combine them on the job.

The other caution involves interaction between tasks or skill components. A simple-minded example would be turning and banking an aircraft; the tighter the turn (and the higher the speed) the sharper one must bank, and the two must be nicely coordinated, so they should be trained together. In electronics maintenance there are adjustments which interact; these should be taught at the same time. In combat leadership, numerous, sometimes conflicting demands often arise simultaneously. Training should include practice in allocating available resources (men, weapons, transportation) appropriately, and keeping training in transportation management entirely separate from that in weapons utilization would probably result in inappropriate decisions on the job in some cases.

All of these principles will come into play in developing a training program. It is not a question of either-or, it is a question of a suitable molding of most or all of these principles to produce a good training program. This is a prelude to re-emphasizing a principle which should run through the whole job of developing a training program. This principle is that what a man learns should be meaningful to him, at all stages of training. This means that each new skill or piece of information should fit into what the man already knows, and make sense. The need for the new skill or piece of information should be obvious, so that the trainee is not asked to learn what appears to him to be irrelevant material. If this can be done in developing a training program, learning and retention should be better, and transfer should be facilitated.

Making learning meaningful usually starts with giving the trainee an overall sketch of the whole job or performance to be learned, so that he can see how later, more concentrated study on particular aspects of the job or performance fits into the whole picture. From demonstrations or actual trainee experience with the job at a simple level, the student can begin learning what the whole job is about, and can be led to see that, if certain results are to be obtained (if the rifle is to fire reliably, or if the radio is to receive clearly), certain operations or checks must be performed. Thus, two of the major elements in making learning meaningful are a picture of the whole job into which the details can be fitted, and an understanding of the desired outputs or results of performing the job to give focus and purpose to the instruction.

Transfer in Transition, Retraining, or Cross-Training. If a man is to be trained in an altered version of a job he has been doing, or in a different job in the same system, much of his previous training and experience may transfer to the new performance required. The problem in developing training in this case is to carefully explore the extent and nature of the changed performance or content involved, and devise suitable training for this portion of the job. In some cases the altered or new performance may require different responses to the same stimuli, and this is especially likely to result in negative transfer, that is, mistakes, slow learning, or inefficient performance generally. Special attention should be given to such situations in developing the training program.

Transfer of Knowledge. Much of what is taught in most training courses does not involve actual performance of the job being trained, but rather consists of knowledge or information necessary to perform the job. It is easy to include all kinds of information in a course, on the blithe assumption that it is needed, "and even if it isn't absolutely necessary, it will help them some day in some way." If careful procedures were followed in identifying knowledge requirements when performance requirements were established, the information to be taught should be relevant, and this is a big step toward obtaining good transfer to later [illegible]nce

One further matter should be emphasized in this connection: A high degree of mastery of knowledge is necessary before substantial transfer can be expected. This means that simply exposing a student quickly to principles and facts involved in the relationships of pressure, volume, temperature, and velocity of gases will probably not help him much in understanding how a carburetor works, and why one can freeze up under certain conditions. The student needs a rather thorough understanding of the relevant information and principles before much transfer to carburetor problems can be expected to occur.

Whole-Part Learning

You may hear some mention of whole-part learning. This is the question of whether it is better to study what is to be learned all in one unit, or to divide it into smaller sections to be learned separately and then combined. The answer to this question depends on so many qualifications that it simply is not profitable to ask it in the context of most military training situations. Unless the amount to be learned is relatively small, it must be divided in any case, and much of what we have said about establishing performance requirements and developing a training program involves carefully analyzing and dividing the information or performance to be learned. Thus any training you plan will almost certainly involve dividing the material into tasks or other sections.

Training Devices, Aids, and Simulators

This is an area in which transfer of training is a matter of prime concern; the whole idea of a training device or simulator would be pointless if substantial transfer were not obtained.

Some definitions are in order first. A *training device* is used in teaching some skill or physical performance. It has, in some form, controls which the student manipulates, and indicators from which the student obtains information on the effects of manipulating the controls. The student is active in using a training device.

The term *training aid* covers a broad category of devices or techniques which aid in presenting knowledge in classrooms or other learning locations. Slides, charts, films, tape recorders, television, and even books—though they are taken for granted now—are examples of training aids. This category is too large and its boundaries too indefinite to consider at length here.

A *simulator* is what might be called a high fidelity training device. By this it is meant that a simulator is, in all respects from the point of view of the man being trained, very similar to the real equipment on the job.

The main considerations in training devices are effective training—that is, high positive transfer to the job—and cost. High fidelity training devices or simulators are usually very expensive. Where equipment of any size or complexity is involved (e.g., aircraft, automotive equipment such as tanks or even ordinary cars, air defense or air traffic control systems), a good simulator can easily cost from $100,000 to several million dollars. And from a practical point of view in most military training situations, several years of lead time are usually required for drafting requirements, obtaining budget allocations, engineering development, and finally manufacturing such high fidelity training devices.

The main point to be made here is that a great deal of training can be accomplished with simple, cheap, low fidelity training devices. Some people get infatuated with getting the highest possible fidelity in a training device, but such devices cost so much that not many can be obtained and most students, therefore, cannot spend much time learning with such a device.

Several studies have shown that low cost, low fidelity devices can accomplish a large part of the training needed. A long, fixed-procedure task on a control panel in the Nike

Hercules system was taught just as well with a line drawing of the panel on a 5 x 8-inch card as with a $3000 simulator (Cox, *et al.*, 5).

An inexpensive mock-up of the instrument panel and driver's controls on a tank was just as effective as a more expensive trainer or the tank itself in teaching starting and stopping procedures and information about the driver's instruments and controls (Denenberg, 6).

During study of teaching of ground cockpit procedures for an aircraft, training on a simple cockpit mock-up was found to transfer very well to procedures performed in the aircraft. Training in flight procedures was successfully accomplished by use of a full fidelity simulator, a cold simulator, and a photographic mock-up (Dougherty, *et al.*, 7). Aircraft basic instrument and radio range training have been taught equally well with two devices at different levels of fidelity (Wilcoxon, *et al.*, 8).

Torkelson (9) trained ROTC students and recruits in the nomenclature and function of antiaircraft weapons using a mock-up, a cutaway, and charts. Performance of the ROTC group revealed no differences in effectiveness of the devices, while the recruits showed equal performance after training with the mock-up and cutaway but low performance on black-and-white charts.

In retraining Air Force mechanics on B-47 fuel, hydraulics, or rudder power control systems, a comparison was made of several types of training devices which varied in level of functional fidelity, although this factor was not a concern in the study (Swanson, 10). The devices were an operating mock-up, a nonoperating mock-up, a cutaway, an animated panel, charts, and symbolic diagrams. No differences in proficiency were found among those training with different devices, and there were still no differences six to eight weeks later.

This is not to say that simple, cheap training devices can accomplish all the training needed. Usually such a device will be useful in training on some segment of a task, and the integration of this segment with the whole task usually must be accomplished either on a higher-fidelity simulator or more commonly on the operational equipment itself. The point is that much of the training can be accomplished on simple devices, at a much lower cost than with expensive simulators or actual equipment.

Some kinds of training may require high-fidelity simulators, even in preference to the actual equipment. Emergency procedures with expensive equipment would be a good example. Such happenings as fires or two-engine operation cannot be practiced every day in real three-to-five-million-dollar 707s or DC-8s, yet a pilot must be trained to meet such situations with rapid, unerring responses to complex patterns of stimuli. The simulators which are used for such conditions look, sound, feel, smell, and even taste like the real thing.

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Establishing Performance Requirements

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The foundation of a sound training program is a thorough understanding of the military systems to which the trained soldier is expected to contribute. It is these systems that create the jobs for which individuals must be trained. This section of the course will describe the way in which systems may be analyzed to identify their training needs.

The attempt to tailor training to job requirements dates back half a century to early motion study with which you may be familiar. Motion study, along with time study and other forms of job analysis, has been used extensively by industry as well as the armed forces as a means of identifying training requirements. However, all methods of job analysis have in common a focus upon an individual actually performing some existing job. A qualified job incumbent is either observed, interviewed, or questionnaired.

While job analysis yields highly valuable information, it has two critical limitations. First, because it requires access to an existing job, the approach cannot be used to predict requirements for future jobs—jobs which no one has yet performed. Second, because the source of information is current job performance, the method cannot be used as a means of improving the way jobs are performed. These limitations became an extreme handicap under the proliferation of complex weapon systems that took place after World War II. Systems became so large, and the relationships among individual jobs so complex, that it became necessary to design each job very carefully in order that the pieces would fit together properly. Moreover, training programs often had to be designed while systems were still on the drawing board in order that qualified personnel might be provided by the time systems became operational. These difficulties led to the "systems analytic" approach to the development of training programs, an approach in which job requirements are identified by analyzing the systems in which they are embedded.

SYSTEMS AND SYSTEMS ANALYSIS DEFINITIONS

In its broadest sense, a system is any set of related functions. We have, for example, systems of mathematics, and "systems" for betting on horses. However, the systems which concern us are collections of men and materiel working together to fulfill some military mission. A tank is a system; so is a tank company, a tank battalion, or an armored division. You can easily see that systems come in assorted sizes. In fact, most systems contain smaller subsystems and are themselves a part of some larger system—like concentric circles. Systems generally overlap one another, too. A track vehicle mechanic may be part of a tactical armor system while at the same time he is a cog in an immense logistics system. He is also part of an Army-wide personnel system which sees that he is treated approximately the same as people in other jobs. Any one job holder has his feet in many systems; this is why we have used the plural, "systems analysis."

To analyze a system means to reduce that system into the various operations that make it up and study the relations among these operations. It means taking the system's mission and analyzing it into the various activities required to carry it out; it means taking the environment under which the mission is performed and determining how it affects the mission; it means taking the various components of the system—the men and

materiel that physically constitute it—and analyzing the way in which they interact to perform the system mission.

A systems analysis performed for training purposes will naturally focus upon one component of the system—the individual to be trained. The individual job holder becomes our unit of analysis. In order to design a training program, it will be necessary to analyze the interaction of this individual with the various systems to which he belongs. However, before we can study these interactions we must first identify all aspects of these systems including their missions, their environments, and their materiel and the other personnel likely to have a bearing on job performance.

The process is one of identifying job-relevant system characteristics. The role of the training manager becomes analogous to that of a detective searching for clues. He must comb the length and breadth of the military establishment seeking points of contact with the individual to be trained. His success, like that of the detective, will depend upon his imagination and diligence. The best we can do is to suggest places that the investigator might look—sources of information concerning system mission, environment, and components. This will consume a major portion of the present discussion. The remainder will be devoted largely to describing methods by which system information is analyzed to reveal the nature of individual jobs.

ANALYZING THE MISSION

A good starting point in the attempt to find out what people must do is identifying the missions assigned to the systems of which they are a part. The identification of system missions includes not only what the system must do, but how well everything must be done. Once the mission and standards of mission performance are known, it is possible to identify the various operations required to complete each mission. These operations will, in turn, be analyzed progressively into smaller and smaller units of activity until individual jobs and job tasks are identified. Here we shall describe sources of mission information, methods of analyzing missions, and finally, establishment of standards for various levels of mission performance.

Sources of Information

Where do we go to find mission information? Three sources which will be described here are: (a) official doctrine, (b) system design data, and (c) experience. The training manager must assure that the widest range of sources has been utilized. Unfortunately, there is no way of knowing in advance whether a particular information source carries implications for the job under investigation. For example, there is NATO—a system broader in scope than our entire national defense system. Would a study of NATO policy aid in determining the job requirements for, say, a tank commander? This cannot be determined without at least a glance at NATO policy.

You can see that a comprehensive systems analysis will involve a lot of unproductive effort—like any good detective work. However, when one considers the number of individuals who may be trained by a given Army course, the benefits gained from anticipating the full range of job requirements will make up for a few unproductive moments.

Official Doctrine

The most direct source of mission information is the body of doctrine under which missions are assigned. While missions are generally assigned by regulation or directive, it is the field manual that generally provides the most comprehensive doctrinal information on unit missions. For example, FM 17-1, Armor Operations, describes the nature of armor operational and support missions.

Official doctrine is frequently the product of extensive research in the form of operations analyses, concept studies, and other analytic efforts by which missions are examined and evaluated. Reports describing these research efforts will often provide more detailed information concerning mission goals and operations than appears in field manuals. For example, an operations analysis frequently reduces a mission into its component operations and may even identify certain quantitative relations between individual operations and mission success.

Any major Army reorganization is typically preceded by extensive study of missions. Reports growing out of these studies will often describe not only the reassignment of missions, but the way it is expected the missions will be carried out. Often various missions can be inferred from purely organizational information documents. For example, in setting up a course in basic infantry land navigation, a study of field army organization was used to determine the type of intra-unit movements, and hence the type of navigational tasks that would be required (1). The most elemental type of doctrine, the standard operating procedures prepared by individual units, may be sampled to get an idea how missions are actually performed in the field. The training manager should assure that a continuing liaison is maintained with the associated Combat Development agencies in order that doctrinal information may be kept current. Indeed, the attempt should be made to look as far into the future as is practical so that doctrinal information does not become obsolete before or shortly after the training program is instituted.

Design Data

Often little thought is given to a system's mission until the system comes into being. In other cases, particularly where costly equipment is involved, systems are designed toward the specific requirements of a particular mission. Under the latter circumstances, an abundance of mission information typically accompanies the development of the system. While this mission information may be closely tied to equipment, it is obviously binding upon the personnel who will use the equipment.

Combat development and derivative studies performed by Combat Development agencies before a project is initiated will explore both combat and support missions. The Qualitative Materiel Requirement (QMR) which officially launches the development of a materiel item will summarize the mission the item is intended to carry out. Mission requirements will be further defined during the "contract definition" phase of materiel development so that, except for changes, the mission of an equipment system is almost totally identified before the actual design of the system commences. Mission data will generally include not only what the system is supposed to do but the speed, accuracy, and reliability with which it is expected to perform. Speed requirements will include such characteristics as system response time, logistic turn-around time, rate of fire, or degree of mobility. Accuracy standards will include such things as maximum allowable fire dispersion, or degree of radar resolution. Reliability requirements will include minimum kill probability, probability of detection, or maximum allowable aborts.

In addition to fulfilling missions, systems create *support missions* of their own. Personnel must be clothed, fed, and transported, and equipment must be maintained. The magnitude of the Army's maintenance mission has increased steadily as more and more military functions have been entrusted to machines. This mission includes not only the preventive and corrective maintenance performed directly upon the equipment, but the administrative and supply operations needed to support maintenance. Support plans are generated early in the concept phase of a materiel development project and continue throughout the contract definition, development, and production phases. Information is contained in such documents as the QMR, contractor proposals, and updated maintenance support plans. The Department of Defense has recently given added emphasis to integrated logistic planning with the result that the amount and quality of information concerning the equipment support mission should greatly improve.

While maintenance concepts will influence the general way in which the maintenance mission is performed, the precise nature of maintenance will be determined by the pattern of potential and real equipment failures. Failure information is therefore an important part of a systems analysis. Early in development, failure predictions may be based upon basic component reliability data. As prototype equipment is developed and tested, failure experience will become available. After the equipment is deployed to the field, maintenance data will be fed back through the Army Equipment Reporting System (TAERS) as well as less formal media. While current feedback procedures are not entirely satisfactory, they do provide valuable information and are undergoing continual improvement.

Performance standards are as applicable to support missions as they are to the combat missions. Accuracy standards for equipment support activities are largely determined by the equipment's design operating tolerances. Reliability requirements in the support area can be determined from the reliability requirements of the overall system since the former has a direct impact upon the latter. How quickly various support activities must be performed will be related to their impact upon the availability of a system to perform its mission.

Experience Data

Once a system has become operational, experience gained in its operation and support will be of particular value in identifying the frequency with which the system is called upon to perform its assigned missions, and in revealing certain missions that would be difficult to anticipate. For example, the missions the aviator aircraft system may be called upon to perform include providing a taxi service, carrying troops into combat, evacuating casualties from combat, reconnaissance, enemy surveillance, courier and messenger duty, artillery spotting, wire laying, area illumination, topological survey, radiological survey, and others. Each of these missions imposes a different set of control, navigation, and communication tasks upon the aviator. It would be difficult to predict with any accuracy the frequency and characteristics of these various missions without recourse to field experience. Where missions are likely to vary substantially from one locale to another, an extensive survey will be required. This usually means questionnaires supplemented, where possible, by interviews. References (2) and (3) provide examples of the use of field surveys in the collection of experience information concerning aviation missions. Where missions are likely to be quite standard throughout the field, experienced personnel locally available are adequate informants.

The objective of a field survey in systems analysis is solely to ascertain the nature and frequency of missions. It is not to analyze the way in which missions are performed, and it is not a job analysis. When it can be obtained, field information is a useful adjunct to doctrinal or design data, particularly when it comes to determining the frequency with which various missions must be performed.

Identifying Mission Operations

Once missions have been identified, they must be analyzed into their component operations before individual job requirements can be determined. As an example, some of the major operations of an aviation mission are shown in Figure 1. The identification of major mission operations is really the first step in the lengthy process which will continue right through the identification and analysis of tasks, to be discussed in later sections of the course, down to the level of individual job procedure. Therefore, the graphic sequence diagram or mission profile shown in Figure 1 is only a convenient starting point. Eventually, it will be necessary to transfer to a tabular format in order to record all of the information such as performance standards, skills and knowledges, and physical requirements which must be correlated with each step in performance of the mission.

Planning Phase of Aviation Mission (From Ref. 4)

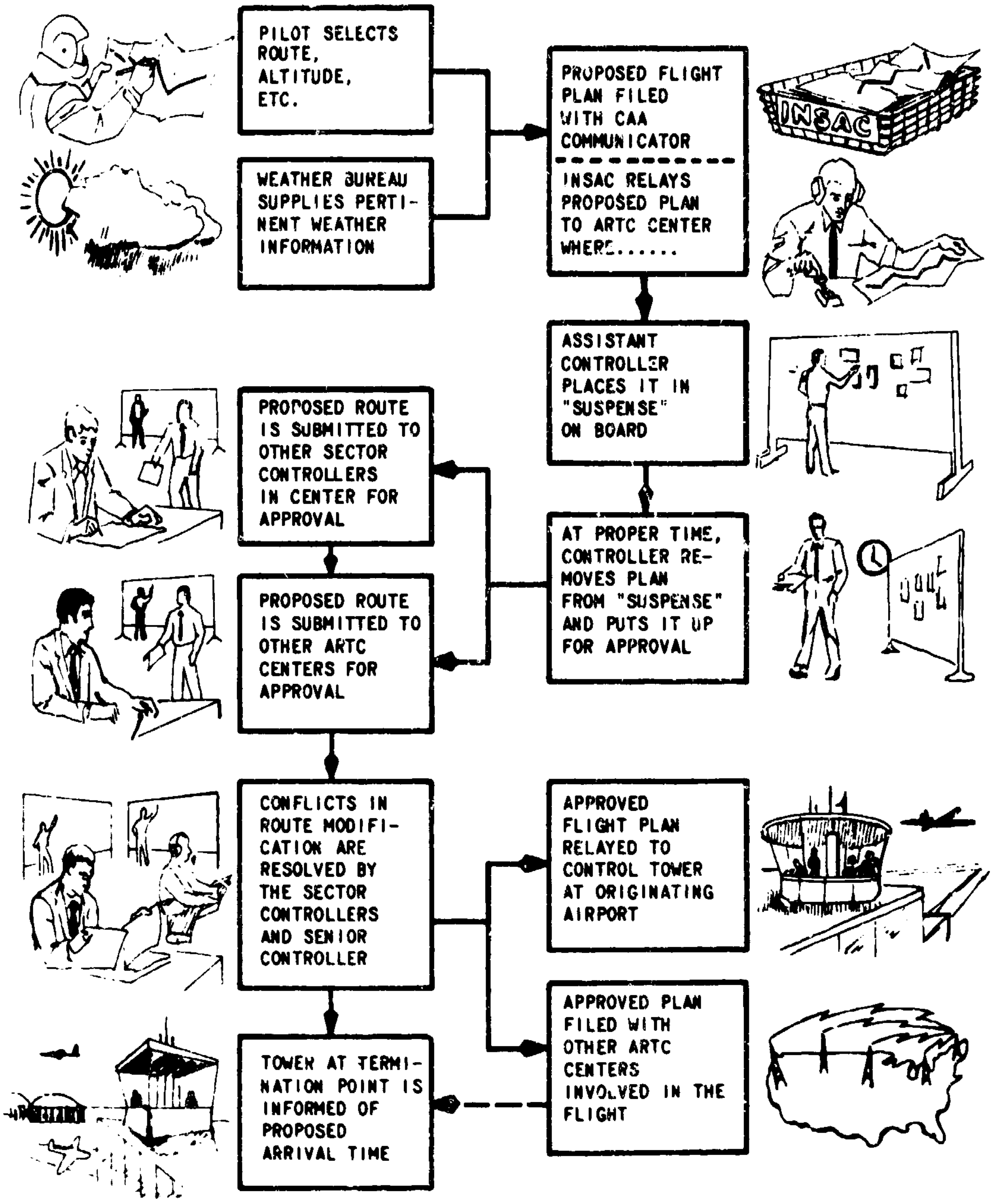

Figure 1

Recently, extensive use has been made of automated data processing procedures in order to expedite updating, printing, and tabulating of analytic data.

Where time is critical to performance of a mission, as is often the case in tactical missions, the operations may be listed along a graduated time scale. This aids in

identifying time-critical relationships such as time limits for certain activities, rapid interaction among individuals and groups, and individual overloads, that is, asking one person to do too much in a short time.

The mission shown in Figure 1 is a "discrete" mission, that is, it has a clear beginning and end. Other missions, such as that of a maintenance depot, are continuous in nature. In a continuous mission, all operations are performed simultaneously rather than appearing in sequence. However, even though the operations are simultaneous, they occur in a particular order with respect to some product, such as an item under repair in a maintenance depot.

This order or "flow" of operations can be depicted graphically. Flow diagrams can become quite complex, as witness Figure 2. In some cases, the result of one operation may determine which of two subsequent operations is performed next. For example, if an assembly entering a maintenance depot tests satisfactorily it will follow a different path from one which requires repair. Several such branching flows may be seen in Figure 2. Sometimes a particular operation may have to be repeated. For example, a repaired assembly may have to be recycled through the test sequence. Since there is no absolute time dimension on a flow chart, it is customary to show this recycling as a feedback to the repeated operation rather than to show a separate operation.

The various human activities which go to make up a particular operation may be quite unrelated to one another so far as their underlying skills and knowledges are concerned. The term "function" is frequently used in reference to activities sharing the same underlying skills and knowledges. For example, the activities involved in navigating are highly related even though they occur at different points in the course of a mission. Navigation could be considered a function as could aircraft control or radio communication. Functions therefore cut across operations. A function such as electronic signal tracing may occur in a number of maintenance operations.

Normally, various functions will be revealed as the analysis of operations, duties, tasks, and so on, continues. However, it behooves the analyst to identify as many relevant functions as he can at the outset of analysis in order to assure that important activities will not be overlooked. For instance, in analyzing the take-off phase of an aviation mission, attention of the analyst might be drawn to the function of aircraft control, to the exclusion of the voice communications function. Being forced to consider communications lessens the chance of oversight. Going back to what we said earlier about good detective work, any procedure which will alert us to relevant clues should be exploited. In a tabular representation, operations are often listed along one dimension and functions along the other, thus forming a matrix. Each operation can then be compared with each function and some notation made in those cells which correspond to related functions. Forcing the analyst to examine each cell—that is, each combination of function and operation—reduces the chance of overlooking something.

Like other phases of systems analysis, the reduction of missions into operations, duties, tasks, and so forth requires a team of specialists including individuals knowledgeable in relevant military doctrine, combat developments, tactics, logistics, operations analysis, engineering, and personnel. In large equipment systems, the responsibility for analyzing missions usually falls upon the development contractor.

Mission Performance Standards

As missions are analyzed into their operations, it is desirable to assign some standards of speed, accuracy, and reliability to each subordinate level of mission performance. It is generally unrealistic to think of setting absolute standards of human performance. After all, there are limits to human capabilities and they aren't the same for all people. While it is true that some operations such as a missile count-down are designed

Analysis of Supply Operation (From Ref. 5)

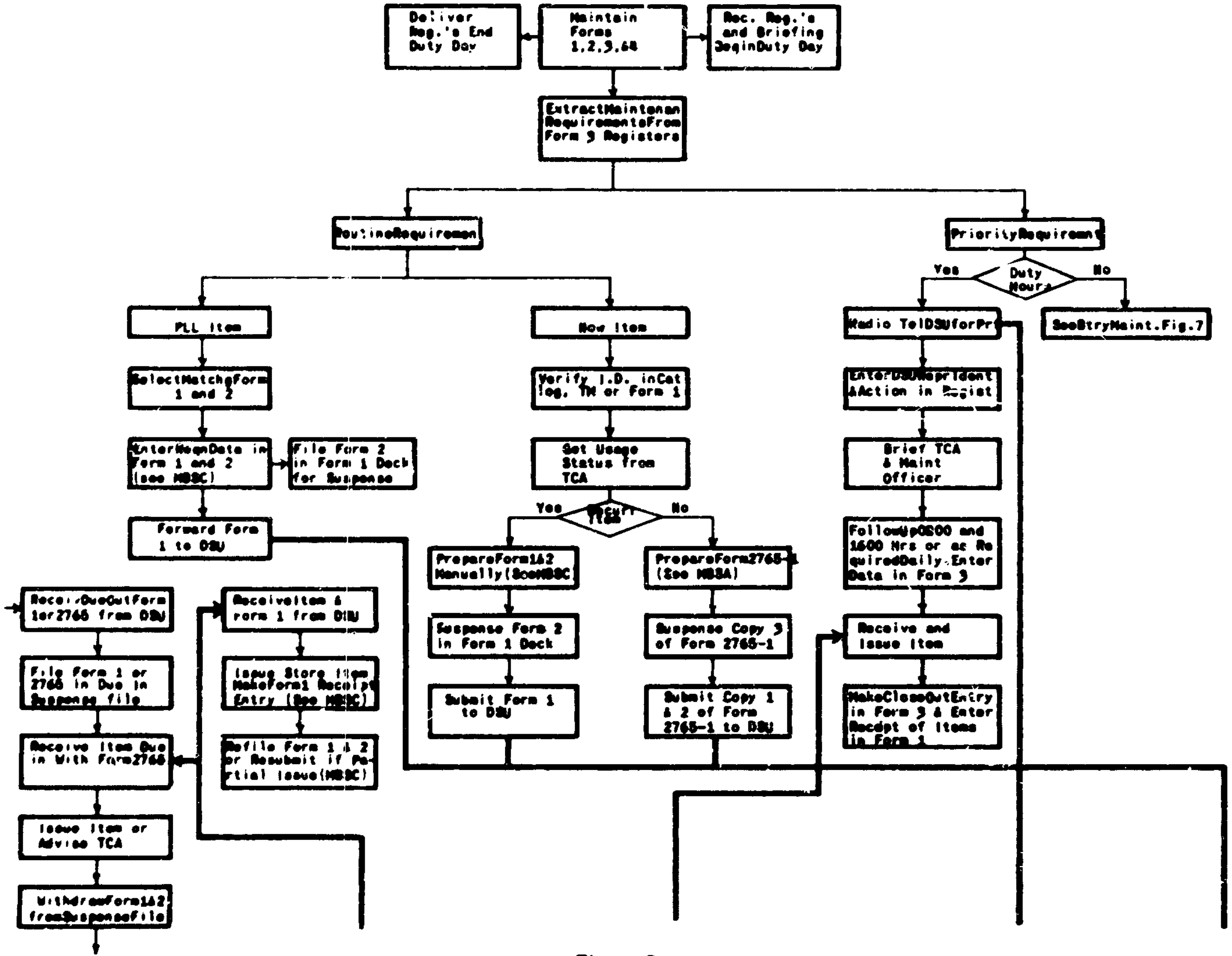

Figure 2

to proceed at a particular rate of speed, the rate can be maintained only if it is set in terms of known human capabilities; this is the goal of human engineering. In any case, should any standards exceed human capabilities it is the standards that will have to be changed.

What we generally do at this point is to establish the relative standards, that is, to determine the relative importance of various performance parameters to mission success. The field commander would, of course, like performance to be maximum in all respects on all tasks—a noble goal, but a practical unreality. The trainee would never leave school. What must be done is to trade one standard against another in a way which will allow the training manager to use his limited training resources efficiently. On the one hand, we can seek trade-offs *among performance parameters* for a particular operation. For example, we may wish to know which is more important to a given operation, speed or accuracy. The answer would assist us later in the analysis to determine whether the operation is best entrusted to a rapid, somewhat unsure method, or to a slow, but extremely accurate method.

Conversely, we may seek trade-offs *among operations* relative to a given parameter of performance. For example, we may wish to know which of several operations demands the most reliable performance. An answer here would help us spend our training time where it will do the most good. It is only after a training system has actually been developed and we know what procedures will be used to perform the job, as well as the skills and knowledges that will be obtained through selection, school training, and OJT, that we can hope to set a realistic absolute standard of performance.

This discussion of mission analysis will close with a listing of some of the more important determiners of speed, accuracy, and reliability.

Speed. How quickly an operation must be performed will depend upon such factors as the following:

(1) **Absolute speed requirements.** It must be recorded whether any time limits designed into the system, such as count-down, can really be attained or not.

(2) **Criticality.** Where no specific time limits are imposed, we want to know how directly the operation affects mission performance. For example, organizational maintenance is generally more critical to the ability of a missile to perform its mission than is support maintenance. Organizational personnel must generally be prepared to move very quickly to correct malfunctions which disable the system.

(3) **Scheduling.** Among those operations that affect mission performance, those for which the need can be anticipated (allowing them to be scheduled for a slack period) are normally less urgent than those which must occur without notice. For this reason, preventive maintenance is generally less critical with respect to time than is corrective maintenance.

(4) **Termination.** Assuming that an operation can be performed during a slack period, can it be terminated or interrupted should the system suddenly be required to perform its mission? A simple surface inspection of an item can generally be performed in a leisurely manner. On the other hand, should disassembly be required, the inspector must be prepared to move quickly so that the item will be available if needed suddenly.

(5) **Frequency.** Generally, the more frequently an operation must be performed, the greater impact the speed with which it is performed will have upon the ability of the system to carry out its mission. For example, a mechanic should be able to operate a piece of common test equipment from memory. However, when using some exotic, specialized piece of equipment, he may be expected to refer to a manual or handbook.

Accuracy. How much variability about the ideal performance is acceptable will depend upon such factors as the following:

(1) **Specific tolerances and critical levels.** As is true with speed requirements, specific accuracy requirements are often designed into a system. This is particularly likely

in the case of equipment-oriented operations where design tolerances and critical levels must be maintained in order that the equipment function properly. Generally, accuracy requirements for non-equipment operations are rather ambiguous.

(2) **Cumulative effects.** Assuming no absolute standards, accuracy is generally more critical where variability accumulates from one operation to another than where it does not. For example, navigational errors will be compounded from one leg of a trip to the next unless they can be corrected at the end of each leg. For this reason, greater accuracy is required in navigating without intermediate checkpoints than in navigating the same distance with checkpoints.

(3) **Error bias.** Where error accumulates over successive operations, it is important to know whether the errors are likely to be random or biased. Random errors will tend to cancel out while a consistent bias will lead to greater and greater inaccuracy. For example, a method of detecting enemy troop strength which is more likely to report false concentrations than to miss true concentrations will lead to consistent overestimates. Greater accuracy is required in the use of this method than one which is equally likely to err in either direction.

Reliability (probability of success). The importance of successfully completing an operation (with sufficient speed or accuracy) will be influenced by the following factors:

(1) **Criticality to mission.** How likely is the mission to succeed if the operation isn't performed? For example, failure to file a flight plan probably is far less critical to satisfactory performance of an airlift operation than is failure to compute the cargo load properly.

(2) **Safety.** How critical is the operation to safety of equipment and personnel? Reliable maintenance is generally more critical in the case of aircraft than in the case of surface vehicles.

(3) **Error detection.** How likely are failures to perform correctly to be detected before they have a chance to degrade mission performance? Errors in tracking targets usually become apparent immediately while errors in navigation may not be discovered, at least until the mission has failed.

(4) **Reversability of errors.** Can an error, if detected, be corrected in time to allow the mission to be performed? A part which if incorrectly installed causes immediate damage, generally demands more reliable performance than one in which errors can be detected before the damage is done.

ANALYSIS OF SYSTEM ENVIRONMENTS

The environments in which systems will operate must be identified in order that their effect upon human performance may be analyzed. This analysis includes the identification of environmental factors having the following effects:

(1) Those that create tasks: For example, cold weather will require that certain protective tasks be performed.

(2) Those that determine when a task will be performed: For example, certain tasks are performed only during daylight.

(3) Those that influence how a task will be performed: For example, overland navigation will require different procedures when rain and fog obscure distant vision than when the weather is clear.

(4) Those that influence the skills and knowledges needed to carry out procedures: For example, greater motor skill is required to control a vehicle on ice than on dry pavement.

In addition to ascertaining the range of potential environmental conditions, we should know the frequency with which the various conditions are likely to arise in the

course of each mission. This information will aid in deciding which conditions should be dealt with through normal training, which through special environmental training, and which through on-the-job training.

Nature of Environmental Factors

The following environmental factors are the ones most likely to have an influence upon human performance:

(1) Illumination. The effect of ilumination level: For example, reconnaissance under day and night conditions.

(2) Terrain. The effect of terrain features such as mountains, vegetation, river beds, and so forth: For example, the operation of certain vehicles in hilly country.

(3) Weather. The effect of wind, rain, fog, and snow: For example, landing an aircraft during a crosswind.

(4) Noise and vibration. Interference arising from equipment, static, weapon fire, wind, and so forth: For example, the use of hand signals when operating noisy equipment.

(5) Enemy. The effect of the enemy's presence (excluding combat where the enemy is part of the mission): For example, maintaining radio silence.

(6) System failures. The effect of failures in the system upon mission performance (excluding maintenance, where failures create the mission): For example, the effect of radio failure upon navigation.

Sources of Information

All of the information sources cited in reference to mission analysis are potential sources of environmental information as well. Any doctrinal publication which assigns a mission is likely to specify the conditions under which the mission is, or is not, to be performed. The development of a new equipment item will often be preceded by extensive analysis of the "environmental envelope" in which the equipment is expected to operate. Naturally, the same envelope applies to the operator. Field surveys have been used to collect data concerning environmental conditions and their frequency of occurrence. The aviator field surveys referenced earlier obtained data on the incidence of crosswind landings, bad weather, icing conditions, equipment failures, and other phenomena. Finally, geological and meteorological surveys are frequently conducted in various locales to survey conditions relevant to military operations.

Methods of Analysis

There is no one established procedure for identifying relevant environmental influences. The only sure way of accounting for such influences is to examine each mission operation, task, procedure, and so on, in the light of the various possible environmental conditions in order to judge the potential influence of each. This approach has been dignified by the term "environmental overlay" in reference to the superimposing of environmental conditions upon the analysis of the mission. The attempt to relate activities to various environmental conditions should continue throughout the analysis of tasks—even down to detailed task elements.

It will frequently happen that the influence of a particular environmental condition will not become apparent until the individual steps in the performance of a procedure are being examined. To assist in accounting for various environmental influences, a column may be added to the mission analysis format for each environmental condition likely to occur, in a manner similar to that described in reference to various functions earlier. This will encourage the analyst to evaluate the potential influence of each environmental factor and allow him to record instances where a significant influence is judged to exist.

Where the environment tends to play a dominant role in mission performance, it may be advantageous to superimpose the mission upon the environment rather than vice versa. For example, in determining job requirements for a land navigation course, various routes were laid out on a variety of maps in order to determine the average maximum distance between checkpoints, what type of accuracy would be required to reach checkpoints, landmarks likely to be available, and so on (1).

ANALYSIS OF SYSTEM COMPONENTS

As military tactical and support systems have grown more and more complicated, the actions of individual soldiers have been increasingly dominated by other components of these systems—by the assistance which these components provide him as well as the demands they make upon him. In order to understand the individual's job, it is necessary to identify all system components, that is, all personnel and items of materiel with which the individual must interact in performing his job.

In later analysis of tasks, the detailed interaction of the individual with the remainder of the system will be analyzed until the inputs or cues which the system provides the individual and the outputs or responses it receives from the individual are identified. Since it is easy to overlook interactions with system components which have not been identified at the outset, the effort must be made to be as comprehensive as possible at this point.

The role of the training manager should not be limited to mere identification of system components. Rather, he should evaluate the allocation of functions to the various components of the system in order to assure himself that the functions left to the individual to be trained are sound—that is, that they neither exceed nor fail to utilize the individual's full capabilities.

Materiel

The term "materiel," even when it is confined to a military context, covers a lot of territory. Major types of materiel and examples of each are as follows:

(1) Equipment:
 Tactical (rifles, tanks, radios).
 Support (trucks, computers, tools, typewriters).
(2) Supplies (ammunition, repair parts, office supplies).
(3) Protective materiel (clothing, containers, gas masks).
(4) Printed job aids (technical manuals, checklists, charts, audio-visual displays).
(5) Facilities (buildings, tables, work space).

The role played by the materiel component of a system will vary in magnitude from one system to another. The distinction has been made between systems which man the arms and those which arm the man. Examples of the former are missile systems, or complex command and control systems. In these "machine-ascendant" systems the actions of personnel are largely responsive to the needs of equipment. At the other extreme would be such "man-ascendent" systems as a rifle squad or, in purely administrative operation, a clerk and a pencil.

Information Sources

Any of the sources of information described in connection with mission analysis is a potential source of information concerning the materiel required to support the mission. Tables of Organization and Equipment as well as Tables of Distribution for the units and organizations which make up a system will generally contain the most detailed equipment lists. Field surveys can be used to ascertain the actual availability of various materiel items; the results should be interpreted cautiously, however, since

personnel in the field are often ignorant of equipment that is not used on a daily basis. The Combat Developments Objectives Guide (CDOG) describes materiel which is under research or development and should be screened periodically as a means of detecting items about to enter the inventory.

The precise nature of equipment is generally described in various documents which accompany their development or purchase. Primary among these are the Qualitative Materiel Requirement, Technical Development Plan, contractor proposals, contract specifications, Logistics Support Plans, and summary reports furnished for in-process or materiel status reviews. Later, as tasks are analyzed in detail, recourse must be had to highly technical engineering descriptions including drawings and blueprints. In fact, where tasks will require access to the internal workings of equipment, as do repair tasks, schematics will have to be consulted. However, the emphasis at this stage is upon identification rather than analysis of equipment.

The training manager must provide the most comprehensive possible survey in order to be sure that every end item and, in the case of large systems, every major component has been accounted for. Anything missed at this point may be omitted from subsequent analysis. Along this line, it is worth noting that any one item of equipment, no matter how large, rarely defines a system. This point is often lost in the case of complex weapons or command and control systems with the result that many important peripheral operations are overlooked. For example, one can easily become so preoccupied with maintenance performed directly upon a missile system that he neglects equally important supply, administrative, or reporting tasks.

Analysis

When a tabular format is employed, additional columns may be provided for listing the equipment used in each mission operation. Frequently separate columns are provided for (a) *prime equipment*, that is, the equipment utilized directly in performing the mission; (b) *ancillary equipment*, that is, the equipment which enables personnel to utilize the prime equipment effectively; and (c) *printed materials*.

One reason for separate listings is to get the analyst thinking about each type of equipment. Moreover, in systems under development, information about each of these types of materiel becomes available during a different phase of development. Since at this stage of the analysis the purpose is merely one of identification, it is not generally necessary to go below the level of individual or major components in listing equipment.

For large equipment systems, the correlation of equipment with mission operations is generally performed by the equipment developer. Often this type of analysis is used by the developer to identify his requirements for various ancillary equipment. Maintenance Allocation Charts are prepared in this way. Recently, attempts have been made to consolidate analyses so that the same analytic data might be used to identify requirements for support equipment, repair parts, publications, personnel selection and classification, and training.

The Maintenance Engineering Analysis Data System (MEADS) being devised by the Army Materiel Command is an example of a consolidated analysis. The MEADS system analyzes mission operations right down to the level of individual task elements and calls for computer storage, retrieval, and printing in order to permit continuous updating and dissemination of information. A consolidated analysis is not only economical but helps to integrate all components of a system and assures that they are all developed toward a common set of activities.

Man-Machine Function Allocation

The role of the training manager should not be confined to mere passive identification of system equipment. Rather, the training manager, as the individual who will be expected to provide qualified personnel to the system, should assure that the design is such as to permit effective use and support of the system by personnel.

Throughout the design of any man-machine system, questions often arise as to whether, or what portion of a given function should be performed by men or machines. The decision may have a critical impact upon selection and training of personnel. An example might be the question as to whether to leave a vehicle control entirely manual, provide a gearing reduction, supply a booster (e.g., power steering), or design a servo control which would maintain a pre-set heading without any involvement of an operator.

There are many system functions which offer similar options as to the degree of automation or manual operation to be employed. Decisions as to how much of a particular function to entrust to the machine and how much to the man should be reached by considering the relative capabilities of each. The following list may prove helpful in evaluating design proposals from the training viewpoint.

The human being is considered best qualified to perform the following functions:

1. Handling unexpected events.
2. Recognizing patterns under changing stimulus conditions (e.g., facial recognition).
3. Profiting from experience (e.g., learning and utilizing the idiosyncrasies of the enemy).
4. Dealing with a wide range of stimuli (e.g., putting sound, noise, and feel together in order to identify some object).
5. Using incidental relevant information (e.g., recalling some road sign that was not considered important at the time it was observed).
6. Detecting signals despite interference (e.g., recognizing speech despite background noise).
7. Improvising, or using flexible procedures (e.g., taking a detour when a particular route is blocked).
8. Functioning under overload (e.g., working extremely hard for short periods even though fatigued).
9. Selecting inputs (e.g., attending to what is important and ignoring what is trivial).
10. Generalizing (e.g., recalling where a particular tactic worked and applying it again in a slightly different situation).
11. Executing a variety of motions (e.g., climbing an antenna tower and gaining access to some internal part to take a measurement).

Equipment is considered best in performing the following functions:

1. Routine monitoring (e.g., detecting unsafe radiation levels).
2. Applying large amounts of force (e.g., lifting heavy objects).
3. Repetitive tasks (e.g., simple sorting of cards).
4. Computing and handling large amounts of information (e.g., lengthy mathematical calculations).
5. Using logical rules for processing information (e.g., use of computers for control of traffic flow).
6. Reacting quickly (e.g., tracking a rapidly moving radar target echo).

Printed Materials

The primary purpose of printed materials of "job aids" as they are frequently called, is to provide information to personnel. Of all materiel items, job aids most closely resemble training in purpose. For this reason, it is important that the content of training be closely correlated with that of printed materials. It would generally be a mistake, for example, to provide detailed procedures in a technical manual where repairmen have been trained to use schematics. Not only the type of content, but the level of reading difficulty the content represents should be a point of coordination between training and job aid development. Publications should not be pitched at a reading level which exceeds

the ability of the training population. Unfortunately, this caveat is too infrequently observed.

An allocation problem arises with respect to the function of communicating information just as it does for other system functions. Some types of job information are best mastered during training while other types are more efficiently acquired as needed through printed job aids. It is true that most job-relevant information will appear to some extent in both places. However, in printing job aids, it is generally desirable to separate reference information from that information which the individual is expected to know—just as the telephone book separates telephone numbers from dialing instructions. Conversely, training programs ordinarily do not aim toward mastery of information that the individual is expected to obtain from job aids.

The following is a list of factors bearing upon the allocation of information "to the head versus the hand."

Frequency of Use. Information that is rarely used tends to be forgotten and should, in most cases, be left to job aids. On the other hand, where information is required frequently, its mastery in training, either school training or OJT, will allow it to be applied more quickly and generally benefit system performance.

Volume. One can only learn so much information at a time. Where a large volume of information is required, it is best to concentrate on certain key items during training and rely upon job aids for the rest.

Problem Solving. Where considerable reasoning is involved in the use of information, such as in performing calculations, it will generally save training and job time as well as reduce aptitude requirements, if problems are solved in advance and the solutions supplied through job aids such as firing tables. On the other hand, if the problems to be solved are fairly simple, it may be quicker to work them out than look them up. For example, a simple troubleshooting block diagram may be easier to use than a cumbersome "cookbook" troubleshooting procedure.

Reliability. Where extremely reliable performance is required, it may be advantageous to force use of a job aid even though the operation could be readily learned. For example, a pre-flight checklist helps to guard against the possibility of oversight.

Stability. The stability of information, that is, how long it will remain accurate and job relevant, is of concern in deciding upon its allocation. In general, the more quickly an item of information is expected to become obsolete, the less value there is in dwelling upon it during training.

Personnel Component

It is a rare job which does not entail working with other people—supervisors, co-workers, subordinates. The personnel component of the systems with which the individual to be trained will be involved must be studied to identify the people with whom he will interact.

Sources of Information

Again, all of the sources of information described earlier are potential sources of information about personnel. The sources of most direct relevance are, of course, TOEs, and TDs, which will identify the responsibilities of all personnel within those units and organizations which make up a system. Also of value are the reports of conceptual studies which precede or accompany major reorganizations such as ROAD, COSTAR, or TASTA-70. While reports of this nature focus largely upon organizational responsibilities, they do permit some insight into working relationships among individuals. For example, knowing how a maintenance direct support unit will support a particular type of combat unit will permit some inferences to be made as to the interaction between organizational mechanics and direct support repairmen. The most detailed standard reference on the

duties of individuals occupying designated positions is the set of MOS descriptions contained in AR 611-201, *Military Occupational Specialties.*

Analysis of Tasks

The various personnel with whom an individual must interact during each phase of a mission should be noted. In a tabular format a separate column may be used for this purpose. Later, as tasks are identified and analyzed, the interactions among personnel will enter the description of tasks, task steps, and elements.

It is generally desirable to analyze tasks in detail *before* they are actually allocated to different individuals as jobs. By examining the task elements, performance standards, skills, knowledges, and performance requirements which underlie mission performance, one is able to assign tasks to jobs in such a way that (a) the skills and knowledges demanded by a given job are relatively homogeneous, (b) the work load is evenly distributed among jobs, (c) work peaks or "overloads" within a job are minimized, (d) movement from place to place is held to a minimum, and (e) all tasks allocated to a given job will actually be required in a given duty assignment. Task analysis becomes a useful tool in job classification and determining unit manning levels.

Even where jobs have already been established, it is beneficial to examine several related jobs at one time rather than approach them individually. Simultaneous analysis allows the training manager to spot improper allocation of tasks at a time when the situation is most easily corrected—when training programs are being developed or modified. Where the analysis encompasses several job positions, it may be a good idea to provide a separate column for each job position and indicate for each operation (and later, each task, step, etc.) those duty positions which are involved. This allows the analyst to grasp the pattern of responsibility more readily and makes it easier to detect imbalances.

Personnel Function Allocation

While we have talked at some length about the allocation of tasks to jobs, it is not individual jobs but rather the Military Occupational Specialty (MOS) toward which most training is conducted. The MOS is a classification device intended largely for the purposes of personnel management. Each MOS symbolizes the ability to perform a particular set of functions, functions which may be required in any of a number of jobs. Where training is MOS-producing, the allocation of functions among MOS is of even greater concern to the training manager than the make-up of individual jobs.

First, the breadth of the MOS is of critical concern. Everything else equal, the more functions are contained within a MOS, the more time it will take to train an individual to fulfill the MOS description. Therefore, it is in the interest of training to seek a high degree of specialization. However, a large number of narrow specialties is difficult to keep adequately staffed. Consequently, specialization is uneconomical from a personnel management viewpoint. Somewhere between the extremes of narrow specialization and the all-purpose soldier is the optimum degree of specialization. The training manager must be prepared to participate in trade-off studies aimed at seeking the optimum.

The vertical alignment of functions, that is, the allocation of tasks to different skill levels within an MOS, is also a matter that concerns training greatly It is not very efficient to train everyone, first enlistments and careerists alike, to the same level—not when you consider that about 80% of the former will leave the Army at the close of their first enlistment. It generally makes more sense, particularly in highly technical MOSs, to gear the size of the training investment to the potential return. This means confining the costliest training to the prospective career soldier and limiting entry training to the apprentice level. It is the responsibility of the training manager to see that tasks are allocated to entry and advanced courses in a way that will create a logical pattern of increasing skill and responsibility.

SUMMARY

The main thrust of this section on systems analysis has been an emphasis upon the importance of preceding any development of a training program with a thorough examination of the military systems which will consume the products of training. Since analysis of military systems forms the foundation of a sound training development process, and since training programs can be no broader than this foundation, a comprehensive survey of systems is paramount. Systems analysis has been likened to detective work in the sense that there is no method available which will guarantee that all relevant sources of system information are revealed. It helps to identify missions which systems must perform and to reduce each mission into its required sequence of operations. This reduction places us in a better position to judge the relevance of various system characteristics, including its people, its materiel, and its environment, to the jobs of individual soldiers. We have also suggested some specific aspects of systems which have potential job relevance as well as likely information sources.

While our primary interest has been the influence of systems upon training, we have also commented upon the reverse relationship, that is, the constraints which training places upon the design of systems. Since the training manager bears responsibility for furnishing qualified troops to operate and support systems, he is obliged to do what he can to make sure that the demands of systems neither exceed nor fail to utilize his ability to meet them. Systems analysis provides a means of meeting this obligation.

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Some Guidelines for Designing Technical Manuals for Use in Training

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I. **Development by user testing.** The most important guideline is: ***test the training publication on the prospective user.*** The development of training publications should include repeated revision and retesting until a novice can use the book to guide his performance without error, without assistance, and with little hesitation.

II. **Guiding task performance.** Training publications can effectively guide practice of a task. Such use will affect all aspects of the publications, including format, text, pictures, type, paper, and binding.

A. Information needed to guide practice.

1. **Conciseness.** Training on a task requires the simplest possible directions to guide the action. Task-irrelevant information, background material, and "nice to know" information should not be interspersed with directions designed to guide the action. This may require a whole series of task-sized training publications to present the information now contained in a technical manual. Each "task" is likely to be common to a number of Army jobs (for instance, the assembly-disassembly of the M-73 Machine Gun is required in several jobs).

2. **Analysis of complex tasks.** Sometimes, in order to keep a practice sequence simple, small portions of the task (such as reading a particular scale) will have to be taught first as a subtask. For other tasks, continuity of practice will require that only the simplest problems should be practiced at first. For this reason, emergency procedures are usually omitted during early stages of training.

3. **Sequence.** Present instructions in the sequence in which they are performed. This applies to pictures, paragraphs, sentences, and even phrases within the sentences.

4. **Completeness.** Present each significant point in the action. This can best be achieved, practically, by careful task analysis and thorough development by user testing.

5. **Making practice "purposive."** Instructions should begin by stating the purpose of the action, followed by a summary or outline relating the task objectives to the steps in the action.

B. Use of pictures for training.

1. **Page layout.** A sequence of photographs, or drawings, illustrating one step, or element, in a task (such as removing one part) should be presented on one page or facing pages so the trainee can see all of that step without turning pages.

2. **Relating pictures to words.** Figures, photographs, and drawings should be closely correlated with text material.

3. **Subjective viewpoint.** Photographs and figures should be taken from the trainee's point of regard.

4. **Consistency of camera angle.** Do not change the camera angle (learner's point of view) unless critical cues can only be seen from another angle. In such cases, indicate graphically the change of view.

5. **View "before" the action.** Photographs or drawings should show the present state of the system rather than its state after a response is made. The system status "after" the action should be represented by animation devices, such as arrows or dotted lines, corresponding to the operator's mental image of the desired change.

6. **Avoiding two pictures for one movement.** In presenting a single movement, do not use two separate photographs or drawings to represent the system "before" and "after." This requires the novice to make an extremely difficult discrimination between pictures, even when the difference seems apparent to an experienced person.

7. **Critical cues.** Direct attention to critical cues by relevant animation such as arrows, color coding, etc.

Characteristics of Tests

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Tests come in a variety of shapes and sizes. From our experience, we know that most of them are printed on paper and ask us to select answers from alternatives, write in words or phrases, or compose rather lengthy essays on given topics. A few tests require that we demonstrate a skill, such as driving a car or shooting a rifle. Some are tests of cooperative or team performance; more often, it is an individual's performance that is tested. A test may call for different behaviors. A mechanic, for example, may have to diagnose an ignition trouble, replace a brake cylinder, and fill out a parts requisition form—all on the same test. On the other hand, a test may tap a single behavior—such as an arithmetic test with a hundred addition problems.

Descriptive Characteristics of Tests

Confronted with such an assortment of tests, the question arises: Can they be sorted out and classified as to type? Perhaps they can, but present attempts at classification appear to identify the superficial characteristics of tests. For example, a frequent distinction is made between written (paper-and-pencil) and performance (hands-on-equipment) tests. This seems a reliable distinction at first glance, but is it really? An accountant's job proficiency may be tested with paper and pencil—it is both a written and hands-on-equipment test. Thus, efforts to identify the discriminating features of tests often result in unreliable or, still worse, unimportant characteristics.

The following are four fairly reliable dimensions that may be used in describing tests:

(1) **Personnel Unit Measured.** A test may measure a single person's performance or it may focus on the performance of a system (work crew or larger organizational unit).

(2) **Personnel Unit for Administration.** A test may be separately administered to each person (or team), or it may be administered to several persons (or teams) simultaneously.

(3) **Type of Behavior Tested.** A test may call for knowledge required for performance, or it may require demonstration of the skilled performance itself.

(4) **Scope of Behavior Tested.** A test may cover a variety of tasks (e.g., job proficiency test), or it may be limited to a single task, skill, or knowledge (e.g., test on an enabling objective).

These are *descriptive* characteristics of tests. They are interesting to the extent that they represent traits by which we might label any existing test. Yet this tells us nothing about what is a good test.

Essential Characteristics of Tests

In addition to descriptive, there are other essential characteristics of tests, which should be the concern of the quality control manager. These are summed up in two words, *validity* and *reliability*.

Test validity is commonly defined as the extent to which a test measures what it is supposed to measure. A yardstick is a valid measuring device for distance, whereas a

clock is an invalid instrument for distance measurement; so is a behavioral measuring device more or less valid for measuring some skill or ability.

Reliability refers to the accuracy or reproducibility of the measures taken. An elastic yardstick is unreliable. Just as we would have little confidence in measures of the relative length of objects when an elastic yardstick is used, we would have little confidence in scores indicating the relative performance ability of people when an unreliable test is used.

The concepts of test reliability and validity are central to the problem of test construction. Books have been written on this topic, yet much of the material is given to the technical aspects of analyzing validity and reliability. Our interest will be limited to some simple guidelines for achieving these essential test characteristics. Later, we will return to considerations of these as they pertain to a complete test. For now, however, the discussion will focus on the desirable features of any test item.

Essentail Characteristics of Test Items

Any test item may be evaluated on three criteria: (a) *relevance* to task performance which is being tested, (b) *standardization* of conditions, and (c) *objectivity of scoring*. As you might expect, these derive from the basic characteristics of validity and reliability. If each item in a test is relevant to the task performance being measured, then we are well on our way to achieving validity of the entire test. Similarly, if each test item is administered under standardized conditions, and if student performance can be objectively scored, then we are well on our way to achieving reliability of the entire test.

In looking at each of these three test item criteria more closely, standardization and objectivity of scoring will be covered first; relevance will be discussed last, as it is perhaps the most important and certainly the most difficult to achieve.

Standardization. A test procedure is standardized if the conditions of testing are the same for all examinees. Here the important factors are the test instructions and the environmental conditions under which the test is given.

Whether stated by the tester or written out for the examinee to read, instructions should be identical for everyone. They should be clearly and simply stated, leaving nothing to the interpretation or misinterpretation of the examinee. Things such as the method of scoring and whether speed or accuracy is important should be stressed in the instructions.

The conditions that prevail during testing are of two general types: those pertaining to the test supplies and those pertaining to environmental factors. Both should be constant for all examinees. Items of equipment worked with or on during testing should be restored to their pretest condition if they are used by successive examinees. Electronic devices, for instance, should be recalibrated after each use. Similarly, environmental factors such as visibility, temperature, attitude of the tester, time of day, and the like must be stabilized over successive administrations.

Objectivity of Scoring. Responses in a test situation are objectively scorable to the extent that high agreement can be achieved between independent scorings. Multiple-choice, true-false, and fill-in types of test items are highly objective in this sense. Here scoring is reduced to a simple clerical task. At the other extreme are the so-called essay tests, where it has been observed that a single person is often hard put to rescore the same response with any degree of consistency. Even greater inconsistency results when measured as the agreement between independent scorers.

The scoring process for any type of test should be structured so that only the more reliable human skills are used. That is, the scoring activity should be reduced to one of matching or comparing the test response with some model representing the acceptable response. If the model response to a multiple-choice item is "b," then the scorer has a relatively easy task in judging the acceptability of the letter marked by the examinee.

Unfortunately, responses for many test items cannot be judged in this "either-or" fashion, but require a "more-or-less" type of judgment in comparing with the model response. In this case, we should always strive to break down the model response into elements so that comparative judgments can be made more easily by the scorer. This applies regardless of the type of response involved. Whether it is a motor skill or a written statement of knowledge, if the response is to be scored with any degree of objectivity, a check-list of the necessary components of the model response should be prepared beforehand.

A final point bearing on scoring procedure is important. The method of testing should never be compromised in order to achieve an easier, clearly objective method of scoring. Rather, the most relevant test method should be developed first, and then a maximally objective scoring procedure worked out.

Relevance. As already stated, relevance is the most fundamental consideration in test development. A test item is relevant if it calls for a response that is the same, or nearly the same, as the response required on the job. If, for instance, a soldier is required to know the parts of his rifle, his knowledge should not be evaluated by a multiple-choice test: he should be required to *recall* the nomenclature, not *recognize* it.

Achieving relevance in a test method may well be more of an art than a science. Therefore, it will be easier to introduce the topic by example. Consider the following training objective and related discussion of test development.

> Using binoculars, paper and pencil, and given a series of 20 targets in various degrees of concealment and orientation, and at ranges of 500 to 2500 meters, student estimates and reports range to each target. Student has two minutes per target, and must report the range within ± 50 meters on 16 of the 20 targets.

Performance of this task depends on knowledge of target dimensions, the ability to make precise measurements with the binocular, knowledge of the mil relation, and the ability to correctly perform the arithmetic, division operation.

Under ideal conditions—time and money being no object—student performance on this objective should be evaluated by field test. Test stations, each supervised by a separate tester, could be set up, a standardized instruction read to the student, and the student's terminal performance scored in relation to the standard stated in the objective. This pass-fail score is useful in meeting the quality control requirement of student qualification. A supplemental scoring procedure, for use in training program improvement, should also be used. Here the tester could score the student on the enabling skills and knowledges. With the exception of adjusting and stabilizing the binocular, most of the enabling performances could be objectively evaluated from the numbers that the student writes down in the process of determining range: accuracy in reading the mil scale, accuracy in estimating target size, knowledge of the mil relation, and accuracy in dividing.

This test procedure, though ideal from the standpoint of realism, is hardly practical. The costs in time and support for conducting the test in such a setting would probably not be offset by the gain in authenticity of environmental and target conditions. This is particularly applicable when testing on the less important (in terms of frequency of on-the-job occurrence and criticality to mission accomplishment) student performance objectives.

If it is decided that a "full-field" simulation for performance testing is too much of a luxury, then some alternate method must be devised. It should *not* be too quickly assumed that the only alternative is a paper-and-pencil test of "knowledge of the task." Explicit in the concept of a student performance objective is the notion of an overt, demonstrable behavior. Every effort should be made to create conditions for and

methods of testing that will call for the exhibition of this behavior, and in a form that is as close to the actual job behavior as possible.

Optimal Test Method. The development of an optimal test method short of the full simulation procedure is not easy. For a given task we do not know what conditions and elements of behavior are most critical in terms of transfer from the test situation to the actual job situation. Guidelines do not exist presently for analyzing a task and then reproducing the critical elements into a simulated or synthetic, job-relevant test situation. Nevertheless, training managers concerned with the quality control of their product must get on with the business of proficiency testing. And I believe that substantial improvements in this area could be made if one applies a small measure of common sense and a good deal of effort to the task.

So the problem is one of devising alternative methods of proficiency testing when a field test is uneconomical and when a "job-knowledge" test is obviously inadequate.

You can easily see in Figure 1 that as the simplicity in test method increases, information on component behaviors of the task is lost. Thus, in achieving a simple test method we must sacrifice in two related areas: one is in test relevance (this often drops to a point where there is little justification for spending the testing time); second is the resulting loss in diagnostic information of use to the trainers—that is, if class performance was substandard on this task, was it because they generally failed to attain a stabilized view of the target, *or* because they made constant errors in reading the mil scale, *or* because many of them inaccurately estimated target size, and so forth? The issue here reduces to a tradeoff. How much test relevance and related diagnostic data on enabling performance is one willing to sacrifice in achieving an easier and more economical test method?

In the present example, even without any cost figures, fair guesses can be made as to the economy of the alternate test procedures. A substantial gain in time and money would probably result if methods 1 and 2 were rejected, and only slight additional gains respective to 3 through 7. Also, relatively little is lost in task-relevant behaviors between 2 and either 3 or 4, whereas greater losses are associated with 5, 6, and 7.

Which test method would you recommend?

There are those who would say that the first method is the *only* acceptable one because it *is* the job—therefore the only method that insures relevance. On the other hand, there are those who would maintan that the last method (7) is sufficient because students who do well on one aspect of the job tend to do well on other aspects, so we can sort the better from the poorer students fairly well with even a small sample of their performance.

I don't agree with either of these views.

COMPONENT (ENABLING) BEHAVIORS →

COMPLEX → SIMPLE: METHODS OF TESTING TERMINAL PERFORMANCE

	Adjusts & focuses binocular	Achieves stabilized view of target area	Identifies target or adjacent object of known size	Positions binocular mil scale on target or ranging object	Reads and records mil width or height of target or ranging object	Recalls or estimates & records actual size of target or ranging object	Recalls mil relation	Performs arithmetic division operation to obtain range
1. Full field test as described in objective.	●	●	●	●	●	●	●	●
2. Miniaturized replica of the field test; using toy targets on an indoor range; all to scale	●	●	●	●	●	●	●	●
3. Photographs or drawings of targets mounted at fixed distance from student; student uses binoculars (lens replaced by plain glass with imprinted mil scale.		●	●	●	●	●	●	●
4. Target pictures printed on test; student uses mil scale overlay.			●	●	●	●	●	●
5. Target pictures with superimposed mil scale printed on test.					●	●	●	●
6. Name of target (or ranging object) and value of mil reading given on test.						●	●	●
7. Width or height) of target & value of mil reading given on test.							●	●

Figure 1

Elements of Personnel Selection

William C. Osborn
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The topic of personnel selection is sometimes viewed as irrelevant to Training Management. For in the best of all possible worlds of training, the training manager would very likely maintain that, "It makes no difference what kind of trainees I'm given, my techniques are sufficiently powerful that I can develop any man to the desired level of proficiency." And in the best of all possible worlds of personnel selection, the selection manager would probably contend, "There is little need for formal training, because I can select people having the necessary combination of abilities and skills to perform a job with only minimum familiarization."

Of course, we do not live in either of these ideal worlds, and if we did it would be inefficient to completely replace one of these activities—selection or training—with the other.

Complementary Activities

In the real world, selection and training are contrasting though complementary activities. The performance of a job requires certain skills and knowledges. It is seldom that a person comes to the job with the necessary development of these skills and knowledges so that he can immediately perform the job to the required standards. Some form of training is usually needed to shape these characteristics into the desired job behaviors. At the same time, the training burden may be eased and the ultimate operation of the system upgraded in proportion to the quality of talent initially brought into the system. Given a choice among people to be hired, it is only sensible to try to select those who have the greatest potential for contributing to the mission of the system.

The training manager must first understand the workings of a personnel selection system if he is to effectively work with the interface between selection and training. However, personnel selection is not a simple subject matter, so I have chosen to concentrate on the logic of personnel selection—largely to the exclusion of specific interactions between selection and training.

Interactions do, of course, exist. For example, during the engineering of a system, initial tradeoff decisions must be made in allocating performance skills to be either trained or selected. Also, under certain conditions, trainability may be the criterion for which people are selcted. Or, performance during the early stages of training may at times be used as a predictor of eventual job success. Of course, the most obvious dependency is that the selection process determines the initial abilty level of trainees. All of these represent specific areas of overlap between the selection and training systems, and as such I won't go beyond pointing them out. We will focus on the general objective of communicating the concepts and logic underlying personnel selection. Later we will attempt to indicate how selection as well as training fit into the total personnel management picture.

We all have experienced selection, or perhaps rejection, for jobs at various times in our careers. The fact of your present status indicates that you survived the screening requirements for the Advanced Officers Course. When entering the Army, you had to meet certain physical and mental standards. You also had to satisfy certain academic

requirements to qualify for entrance to college. Perhaps you have experienced other instances in which you were tested, interviewed, or otherwise evaluated—presumably to judge the likelihood of your succeeding in a particular job. It is also possible that at one time or another you may have questioned or at least been curious about this selection business—particularly if at some time you failed to qualify for a job.

Without actually trying a man out on the job, how can it be known whether he would make a good lathe operator, platoon leader, medical student, or whatever? Perhaps it can't be known in any precise sense. Yet, as an employer, if I need a salesman, I have got to be selective. If I let applicants draw straws, the odds are very much against my getting the best potential salesman. Without a crystal ball, how should I go about improving on those odds? This is the question I will try to answer.

Definition of Personnel Selection

The critical or terminal behavior that characterizes personnel selection is, in its simplest sense, a decision. Given a job vacancy and two job applicants, a choice must be made between them. Or, given two different job openings and two job applicants, a decision must be made as to which applicant will be assigned to which job. Obviously, the difficulty of this decision will vary according to the number and type of jobs to be filled, the number of people available to fill them, and the complexity of the rules followed in deciding who will be chosen and to which jobs they will be assigned. Yet regardless of the complexity of the selection decision, the same three essential elements are involved: job openings, job applicants, and a decision rule.

We should further note that some decision rule is being followed in any selection situation. Positions may be filled simply by selecting people on a "first-applied-first-hired" basis. Or, applicants may be sorted on the basis of some measured trait such as height, and the tallest chosen first. Or, perhaps a more complicated rule is followed in which all non-high school graduates are dropped from a group of applicants; then, from among the remaining candidates, those scoring above a certain qualifying level on a test of mental ability are interviewed and the final selection made on the basis of the interviewer's recommendation.

As in any decision process, the quality of the selection decision will depend on the systematic research that has gone into preparing estimates of the costs and expected gains associated with the alternate choices available. For example, why spend the time and trouble measuring height of job applicants and then using this measure as the basis for the man's acceptance or rejection, *unless there is reliable research evidence* indicating that tall people tend to perform better on a particular job? This *research activity* is the real substance of the selection process—it is the foundation for setting up the decision rule used to choose among people.

It is convenient to maintain a distinction between the data gathering or research phase of personnel selection, and the data implementing or administrative phase. We will discuss these separately.

Personnel Selection: A Research Activity

Selection research involves answering three specific questions:

(1) What are the relevant job performance attributes we wish our personnel to possess, and how can they be measured?

(2) What are the personal attributes which might prove useful in predicting the job performance criteria, and how can these be measured?

(3) Do people with a particular pattern of personal attributes tend to perform better on the criteria attributes?

The general framework for data pertaining to these research questions appears in Figure 1.

Personnel Selection Model

		Predictors (Personal Attributes) 1 2 3 . . . P	Criteria (Job Attributes) 1 2 3 . . . C
People	1		
	2		
	3		
	.		
	.		
	.		
	N		

Figure 1

Ideally, for each person we want to obtain a measure on each personal attribute and each job attribute. Then, with this kind of display, we can search for common patterns between predictor measures and criterion measures. Let's look at each of these questions more closely.

Criterion Attributes. Any human performance variable that contributes to the mission of a system will be considered a potential criterion attribute. Productivity, error-free performance, time on the job, advancement in the organization—all are examples of qualities which may indicate an individual's contribution to successful system performance. These are the relevant attributes in our selection model. They represent the criterion behaviors which, by definition, are critical to the system's operation, and which we hope to improve over the long run through improved personnel selection procedures.

There are two stages in the development of criterion measures for a given job. The first involves the definition of the important characteristics or attributes of successful job performance. The second centers on the problem of quantifying or finding some yardstick to use for a particular attribute. The job attributes included in a criterion measure must reflect the goals of the organization. As organizational goals or mission statements are the basis for system and subsystem description, it follows that the resulting job descriptions offer the best source—that is, the most *relevant* source—of job attributes. Specifically, the requirements or standards for a job indicate the attributes which a performance criterion must represent.

The problem of transforming the job criteria into a usable and meaningful measure is the next step. Even in those circumstances where clear statements of job standards are available, cost, time, and convenience often influence the method of measurement. Proficiency measurement is of general interest here. It provides criteria of job performance which are useful in many systems research and administrative activities. It will be of particular interest because of its central role in the evaluation of training. Thus, it will be covered as a separate topic later in the course. Here, our focus is in on it as a criterion for evaluating selection procedures. Accordingly, we will look only at classes of performance criteria, and not go into the techniques of developing them.

The yardsticks used in measuring job proficiency are of three general types: performance samples, performance indicators, and performance ratings.

Performance sampling is a method of direct measurement of a man's job proficiency. This is accomplished by observing and scoring his performance on a job sample test. Under ideal conditions, this method of proficiency measurement is probably the best.

The problems on such a test must be representative of what is actually required on the job. That is, the various job duties and tasks should be represented in the sample test, and represented in proportion to their importance and frequency of actual performance. The test should further be representative in the sense that it requires realistic performances, under realistic environmental conditions and reasonably uniform motivation. Other than the technical knowledge and care necessary for the construction of an adequate job sample test, the major difficulties with this form of criterion measurement are the time and expense factors in administration.

Performance indicators are summary measures of job performance. They are the least costly type of criterion measure as they are readily available for most jobs. They may take different forms: units of production, time with the company, salary, number of absences, number of accidents, amount of waste, and so forth. As criteria, you can see that these have the desirable features of being objective measures, yet they are more or less indirect *indicators* of job competence. They are typically most useful for the simpler, routine jobs. In a repetitive assembly task, for example, the rate of error-free production could be easily obtained, and would yield a proficiency index much the same as one would expect from a job sample test. These performance indicators are less useful as criteria in more complex jobs. They are generally only symptomatic of job performance and are used simply because they are available and highly measurable. Where proficiency testing is not feasible, frequently some combination of these objective proficiency indicators offers a usable substitute.

Performance ratings are the weakest and perhaps most widely used method of criterion measurement. They entail the judgment or rating of a person's work performance by supervisors, co-workers, or anyone else who is familiar with the job-holder's day-to-day performance. The rating may require comparative judgments of total performance, such as "who is the best automotive mechanic, Jones or Smith," or the rating may be done separately by job duty for each man, such as, "using a nine-point scale, rate Jones on his ability to troubleshoot electrical circuits." Performance ratings are often used for jobs in which no clearly defined productivity measure is available; or for jobs requiring a variety of duties that are otherwise difficult to apply a yardstick to—managerial jobs, for instance. The rating method is a relatively easy way to obtain criterion data, but unfortunately it is fraught with many shortcomings, most of which center on the problem of getting raters to judge people on actual performance and not some irrelevant dimension such as how likeable they are.

Once the significant job behaviors have been determined, and one of these measurement techniques applied, the selection researcher has something to shoot for—a quantitative and presumably *relevant* criterion against which he may test measures of behavior taken *before* people are assigned to the job.

Personal Attributes. Characteristic behaviors which people bring to the employment situation we will call personal attributes; and this is intended in a most general sense. These attributes may be physical or mental; they may have been learned or determined at birth or acquired by circumstance. Intelligence, eye sight, marital status, formal schooling, manual dexterity, height, work experience, aggressiveness, creativity, the list goes on and on. Viewing these personal attributes as potential predictors of future job success, the selection researcher must first choose attributes which he thinks bear some logical similarity to job behaviors, and then determine a method of measuring them.

The process of identifying potentially useful predictor attributes is much the same as in identifying job attributes. Job analysis data again becomes the basic source of information. Here however, rather than the task statements and standards, the list of required skills and knowledges is the focal point. These skill and knowledge factors suggest which personal attributes we might reasonably expect to contribute to eventual success on the job.

An analysis of basic human abilities and their measuement is beyond the scope of this discussion. So we will take a brief look at methods of measurement typically used in selection work. These include psychological tests, biographical questionnaires, and interviews and personal references. Any such measuring device should be used with three objectives in mind: (a) to provide for a controlled observation of some aspect of human behavior; (b) to provide the *direct* measure of a specific, relevant attribute, and (c) to provide an objective, reliable, and quantitative score. How well do each of these measuring devices satisfy these objectives?

Psychological tests are the strongest in terms of our objectives. They constitute standard and controlled stimulus situations which can be used to elicit behaviors presumably relevant to job requirements. In a job that requires the frequent and rapid use of numerical operations, for instance, it might be useful to try out a standard test of arithmetic speed; or for an assembly job, one of the tests of manual dexterity might prove useful. Tests, whether of general ability or of specific knowledge or skill, have the further advantage of being objectively and reliably scored.

Biographical data also have this asset of being easily quantified. The major drawback in the use of items of biographical information is that they are only indirect measures of personal attributes. Years of formal schooling, for example, is only an indirect measure of intelligence, and would be a poor substitute for a test of mental ability. On the other hand, we may be interested in attributes for which there are no purely objective tests. The ability to work effectively with other people, for instance, may be a skill of particular importance in certain managerial jobs, and may best be measured only indirectly through such biographical items as the number of social and community activities.

Personal interviews and letters of recommendation, the most widely used of the selection devices, have the same intended advantage of getting at those attributes not easily measured by tests. These devices have the common disadvantage of relying on usually unstandardized and subjective impressions in producing any usable attribute measure.

The method used to measure predictor attributes is most dependent on the nature of the attribute. The administration time used is less a factor in choosing among measurement alternatives for predictor attributes than for criterion attributes. It generally takes no more time to administer a few short tests than to conduct an interview although, as we mentioned, some personal attributes are not easily tested, and may only be estimated by someone's judgment.

Now let us assume that a measureable set of attributes has been proposed as important to a given job, and that a criterion measure of job performance exists. What does the researcher do with these measures? Once the proposed characteristics of job candidates have been measured, how are these attributes evaluated in terms of usefulness in predicting later job behavior? This is the validation process of selection research.

Validation of the Selection Model

The fundamental task in this validation process is that of determining the relationship between a predictor measure and a criterion measure. To what extent do people who initially scored high on a predictor measure tend to also score high on a later measure of job proficiency? The relationship between two such measures is called a correlation and, as it is a basic tool in selection research, one should have a general notion of its use.

As a simple illustration, consider a group of 12 girls employed as go-go girls in a large night club. Among the personal attribute data compiled when these girls were hired, the selection researcher is considering four measures: age, previous dancing experience, an interviewer's judgment of physical appearance, and an objective, composite measure of body build derived from the three traditional tape-measure indices. As a measure of

current job performance, the night club patrons were polled and each cast his ballot for the "best" dancer. Based on the number of votes received, the 12 performers were rank ordered—the rank of *one* being the most popular dancer, through the 12th ranked, or least popular, as shown in Table 1.

To further simplify the picture, scores on the four predictor variables have been converted to plusses and minuses. That is, for age the six oldest girls were given plus scores, the six youngest given minus scores: the six girls with the greater number of months professional experience in dancing were given plusses, and the six with the least experience given minuses; the scores for judged appearance and body build were similarly coded. With this scoring system, it is easier to see the pattern of relationship between each of the predictors and the criterion ranking. Now, as the personnel selection specialist for this organization, you are interested in the question: "Which of these attributes should I consider as most important when hiring girls in the future?" You can see that the pattern for age—at least within the age range of those already employed—shows no systematic pattern of relationship with the job performance scores. Judged appearance and amount of dance experience show some degree of correlation with the criterion, in that there tend to be more plus scores among the top rated performers.

But obviously the best predictor of success as a go-go dancer in our illustration is the body-build measure—six of the seven highest rated dancers had the top scores on this attribute. So, on the basis of this correlational research data, we would recommend to the personnel manager that when hiring dancers in the future he give less consideration to the age, appearance, and experience of applicants; rather, he should select them primarily in terms of objective measurements of figure as represented by this summary index of body build.

The logic here is fairly obvious. Apparently dancing girls who are well built are the most popular with the majority of a club's patrons; and to the extent that having popular dancing girls contributes to the success of the organization, it behooves the management to select girls for this job who score high on this particular attribute.

Table 1

Data Matrix for Selection of Go-Go Dancers

	Predictor Scores			
Criterion Rank	Age	Appearance	Experience	Body Build
1	−	+	+	+
2	+	+	−	+
3	+	−	+	+
4	−	+	+	+
5	−	−	−	+
6	+	+	+	−
7	−	+	+	+
8	+	+	−	−
9	−	−	+	−
10	+	+	−	−
11	−	−	−	−
12	+	−	−	−

The discovery of valid predictors of job success in any field is typically achieved by this research method—that is, by finding *which* of some initial group of personal attributes demonstrate a significant degree of correlation with successful job performance.

As you may know, the Army also has this sort of selection research activity. The Army's Behavioral Science Research Laboratory (BESRL) conducts studies in which the various personal attributes measured in the Army Classification Battery are correlated with performance criterion measures for large samples of inductees. The criterion measure generally used in these Army studies is performance in a training course. From these correlated analyses, BESRL can make recommendations as to the optimal MOS classification for an inductee, given his pattern of scores on the test battery.

Performance Improvement

Let's return at this point to the distinction made earlier between the research aspect of personnel selection and the administrative aspect. As we have suggested, the research work produces a threefold result: It identifies the personal attributes which are related to later criterion qualification and it determines how these attributes may be measured. But most importantly, the research work should indicate the *degree* of performance improvement to be expected through implementing these procedures.

This last feature is of the greatest interest to the selection administrator. He wants to know just what costs and gains he can expect if he bases his selection decisions on the procedure recommended by research. For example: an aircraft company hires and trains a large number of men to work as machinists. Assume that with the present selection procedures, only about 50% of those brought into the company are satisfactorily completing the training program for this job. A selection study is done by the personnel research group and they report that a test of mechanical aptitude was found to correlate significantly with performance in the training course.

The study was done on 200 men who were given the test at the time of induction and then followed up in terms of performance in the training course. The data are given in Table 2. As you can see, 100 trainees met the criterion of successful completion of training, and 100 did not. These two criterion groups are compared in terms of the relative number within each group scoring at various levels on the aptitude test. The *degree* of correlation between the test and the criterion is reflected in the tendency for those who scored high on the test to be among the successful trainees. Of the 40 individuals scoring above 90 on the aptitude test, 30 of them met the performance

Table 2

Success in Training as a Function of Aptitude Test Score of 200 Aircraft Machinists

Aptitude Test Score	Total N	Number Successes	Number Failures	Percent Successes Rejected (cost)	Percent Failures Rejected (utility)
90-94	40	30	10	70	90
85-89	60	40	20	30	70
80-84	60	26	34	4	36
75-79	40	4	36	0	0
	200	100	100		

Current Failure Rate = 50%

criterion at the end of training, whereas 10 did not. Similarly, for those lowest in aptitude—of the 40 with initial aptitude scores between 75 and 80—only 4 were successfully trained, and 36 proved unsuccessful.

The selection administrator may wish to look at these data a little differently—that is, in terms of the improvement in criterion performance which might be expected if, in the future, he were to hire only those scoring above a particular level on the predictor. This is shown in the last two columns of Table 2, as expected costs and utilities. If he were to select, say, only those applicants scoring 80 or above on the predictor, cost would be the 4% potentially successful trainees who would be rejected by this standard. But this would be offset, on the other hand, by the gain or utility indicated in the 36% potential failures who would be screened *out* by the same selection standard. Or let's say that only the cream is skimmed off by setting the minimum qualification score at 90. You can see that although 90% of the expected failures would be eliminated, it would be at the cost of 70% of the potential trainee successes.

The same data are shown in Figure 2 in graphic form. The solid line shows the expected reduction in training failures as a function of minimum qualification scores on the predictor. The broken line shows the corresponding per cent of all candidates rejected. It is apparent that as the minimum predictor qualification score is raised, two things happen: One is that fewer and fewer potential criterion failures are going to be hired; the other is that an increasingly greater per cent of all applicants are going to be rejected or disqualified by the test.

Expected Reduction in Rate of Training Failures as a Function of Predictor Test

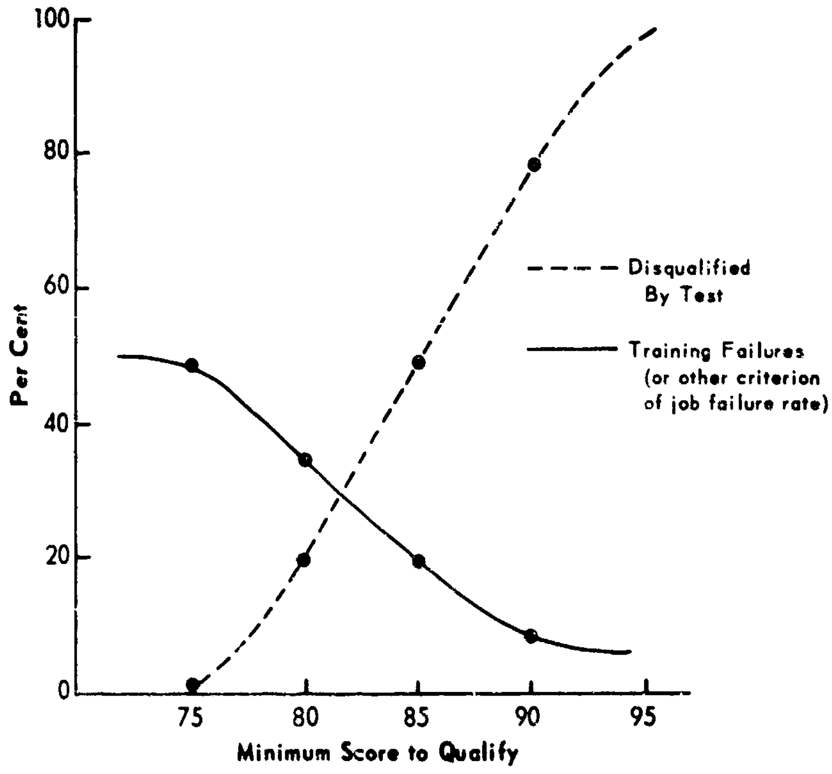

Figure 2

Number of Applicants

This brings us to the greatest single constraint imposed on the selection administrator, namely, the size of the pool of applicants from which his selections are made. Again in reference to the example, let's say that 30 people are needed to begin machinist training, and that we have only 30 applicants. Assuming that the aptitude scores of these 30 people are distributed about the same as for previous candidates, we must expect that, all other things being equal—such as training procedures, and so forth—approximately half of these people will turn out to be training failures.

Obviously, to capitalize on the relationship between the aptitude test and trainability, and to reduce the number of training failures through improved selection in this example, there must be a more intensive recruitment effort. That is, *more* applicants must be brought to the employment situation than can be hired. Say the minimum acceptable failure rate for machinist trainees is decreed to be 20%, and that the burden is solely on the selection administrator to see that this is realized. Reference to his research data shows that for a representative sample of applicants, the selection administrator must set a minimum qualification score of 85 on his predictor measure, if the 20% training-failure criterion is to be achieved. But also, corresponding to the cutting score of 85 is expected applicant rejection rate of 50%. This means, that to obtain 30 applicants meeting cut-off score of 85, he must start with an original pool of twice that many, or about 60 applicants. Of course there will be fluctuations between different samples of people—in a new group of applicants we would not expect *exactly* 50% to score below 85 on the aptitude test, but this is the best estimate, and the one on which the selection system must rely.

The significant point is that, given a valid predictor of performance criterion, the quality of the selection decision may be improved provided there are applicants among whom to choose. If every applicant must be accepted, no improvement over the present degree of criterion success may be expected. And, generally speaking, as the ratio of applicants to the number hired increases, so does the expected rate of successful criterion performers.

Often the personnel selection system has little control over this problem of the selection ratio. We see this occur in the military as well as in other organizations, all of which feel the effect of this restriction at one time or another. In time of peace or when industrial employment in general is down, the recruiting fund is usually large relative to the number of job openings. When this situation exists, selection standards may be raised, and a corresponding increase in system effectiveness expected. At other times, when the situation is characterized by industrial expansion or military mobilization, there is a rise in the number of jobs to be filled; and unless this can be offset by a proportional increase in the recruiting pool, selection standards must be relaxed, with a resulting impact felt in the form of a drop in overall system efficiency.

As this latter case suggests, if the remedy to such problems were left strictly to the personnel selection specialist, he would follow one of two courses: either he would attempt to further refine his selection procedures through more research—that is, try to find better predictors of job performance—or he would simply insist that the organization's recruiting effort be intensified to where he is given more applicants from whom to select.

Fortunately, in practice, when some aspect of system performance involving people is found to be weak, the course of remedial action need not fall to any one of the human factors subsystems alone. The training and human engineering activities, as well as the selection and recruitment groups should be brought together in an attempt to jointly find the most feasible and economical solution. Take the case of the aircraft machinists we have been discussing. The personnel problem there was one of reducing the rate of machinist-trainee failure. The course of action represented a personnel selection solution

of the problem—a solution which we noted might necessitate a corresponding increase in the recruiting activity. Yet in practice, the cost of expanding recruitment much beyond the present level might be high—at least relative to the cost of other possible solutions. Certainly, the possibility of training revision should be considered.

The least costly method of achieving a higher rate of trainee qualification may be to extend training time. Or possibly, the existing training program is not optimally engineered, and some improvement may be effected through better instructional techniques, or through revising course content. Also, the possibility of a human engineering solution should not be overlooked. It may be that through equipment or work-environment modifications—such as the use of job aids—the machinist's job may be simplified; thereby easing the training burden through a reduction in the density of training requirements to be met.

So we see that what was originally viewed as a personnel selection problem may best be considered as common to all of the human factors agencies. The achievement of a workable and low-cost solution to such problems very often lies in some mix of contributions from each of these human factors activities.

It is here that we see the significant interaction between the selection and training functions. While they differ noticeably in method and content, they share a common purpose with the entire human factors system: that of maintaining a high level of human proficiency throughout all levels and all aspects of system performance.

Concepts of Measurement, Test Validity, and Reliability

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The information used in a quality control system for training comes from measurements of human performance. Several aspects of measurement enter into determining how good a measurement is or what its characteristics are. Since measurement is the heart of quality control, the nature of measurements determine how effective a quality control system can be.

Norms, Standards, Specifications

Standards form the framework for making sense of a measurement, for deciding whether it is an indication that things are going well or poorly. Traditionally, in psychology, standards or norms have been relative—how close it is to average or rank compared with others. Armed Forces Qualification Test results, for example, are related to standards indicating percentage rank in the population. The system used for the Army Classification Battery test and area scores is also based on how a man's score compares with the scores of others. Norms and standards based on comparing a man to others are not only classical in psychology but they are useful for a number of purposes such as motivators to stimulate competition among people. Frequently, administrative actions or definitions are best based on such scores as top 5% as honor graduates, standing in class, proficiency pay, and so on, with special pay or privileges for doing better than others.

For selection and assignment of personnel, scores indicating a man is good for a job or poor for a job might be a theoretical ideal, but a selection and assignment system must always make do with the range of talent that is available. Therefore, selection and assignment can be performed with effectiveness using relational scores; wondering whether the "best available" is good enough is likely to be fruitless.

Relational scores are especially efficient for economy in data collection since measurements can be chosen to cover the range of the available pool; in this fashion, test items that all—or none—can answer may be ignored. They are also very compatible with the tool called statistical theory since statistical methods are focused on the average score of a set of measurements and variations from it. Relational measurements are so commonly used that most people are familiar with them. Most colleges use the concept of the bell-shaped curve for grading.

Much psychological measurement is based on relational norms or standards because the state of the art for psychological measuring techniques has not progressed to a point where we can easily do anything else. Questions such as whether the difficulty of a test item is because of subject matter or the way the item is stated make psychologists feel uncomfortable about saying, from a test score, whether a man can actually do something. As a conservative measure, many prefer to stay in the state of the art and deal with how well a man can do something *compared with other men.*

Most physical measurement such as length, weight, and so on is based on absolute norms and standards; that is, measurement with regard to a scale and without regard to the size of other things. For a quality control information system to be most useful, attempts to use absolute norms and standards should be made despite the fact that these are unfamiliar and despite the fact that technically there is an uncertain theoretical basis for using absolute standards.

Norms and standards should be based on *exactly what the system needs* without regard to whether people can do it. These standards also serve as parts of the training objectives for the training system and allow a quality control function of feedback information about where the training program needs to be improved to perform its mission, and as a scale for when a man is qualified for duty.

The approach to absolute standards follows the pattern a design engineer uses. Analysis of equipment and mission characteristics can be done to provide a complete and detailed set of specifications and tolerances for the functions a human being will perform. Assuming we have such absolute standards, each candidate graduate of a training program can be measured for whether he is up to the specifications or not to provide a basis for pass-fail decisions.

Validity

Predictive Validity

Validity relates to the purpose of a test and deals with how well measurements represent the behavior to be measured. Traditionally, information on a test's validity comes from comparing test scores with measures of performance in an operational job. If test scores and criteria of job performance have matched well, we have confidence in later use of test scores; if they do not match, the test scores are of questionable validity. This concept of validity is called *predictive validity* and is used primarily in developing tests as screening aids for the selection and assignment of personnel to jobs.

However, validating a test against job performance is not always possible, nor is it always desirable. Sometimes, such as in proficiency testing for training, a more direct type of validity is needed because, in a sense, the test *is* the job. This approach to validity is "validity by definition." It comes from analyzing the test content, and is appropriately termed *content validity*.

Content Validity

For tests used in the quality control of training, validity is accomplished in two steps. We have already discussed the first step, that of achieving relevance of individual test items. The second step, and the one of interest here, is to insure that the items in a test are a representative sample of the job objectives.

Even though specific items may be valid because each item clearly reflects a specific objective, the test as a whole may not be valid unless it adequately samples the objectives. For example, a test of an electronics technician's proficiency might consist of nothing but problems measuring troubleshooting skill; it would not generally be considered content valid unless it also tested his skill in replacement of components, adjustments and repairs, which are also part of his job. The test should reflect the entire job.

Normally there are more terminal objectives than there is time available to test on. Some sampling procedure must be followed. But how do we decide which objectives (and associated test items) to include and which to exclude from a test?

One criterion that should *not* be used is ease of testing. Rather, the more obvious criteria are (a) criticality to mission accomplishment, and (b) frequency of on-the-job occurrence. Both of these should be determined for each objective, with those lower priority objectives being excluded from the test as restrictions in testing time dictate. Information on frequency and criticality of task performance must come principally from experienced judgment. One method of compiling this data is to have job experts rate each task (terminal objective) as low, medium, or high—first on frequency of on-job occurrence, and second on criticality to mission accomplishment. Frequency of occurrence may sometimes be available from records of field performance; other times reliance must be placed solely on experienced judgments. Similarly, criticality may

sometimes be based on quantitative guidelines of mission accomplishment such as the equipment readiness categories of "red," "amber," "green."

Once these ratings have been obtained, numerical weights such as 1, 2, 3 can be assigned corresponding to the low, medium, high categories, and the two weights summed for each task. This summary index of the relative importance of tasks to a job can then be used to achieve content validity; those tasks with an index of 6 being given highest priority for testing, those with 5 next highest priority, and so forth.

Reliability

In psychological testing, the term reliability is used for a measure of the stability of scores on a measuring instrument. An imaginary elastic yardstick, that stretches or contracts, depending on unknown things, provides a picture of an instrument producing unreliable measures, since a score would not be very repeatable on re-measure.

Reliability as a concept was developed for testing of a single, uniform trait and, for this reason, normal ways to measure reliability rest on comparing a score on one half of a test with the score on the other half. When the scores match (show high correlation), the test is internally consistent and considered reliable—it is expected that re-measures would produce much the same scores as the original ones.

Internal consistency as an approach to reliability does not fit for job performance or potential job performance tests since a job is a conglomerate of many unrelated things, and there is no assurance that one part should relate to another part of the test. Therefore, for job type tests, reliability rests squarely on repeating a set of measurements and comparing the results with the first set. Giving the same test to the same students on two different occasions and comparing the scores to see whether the students make approximately the same scores in both instances is simply not practical in many situations. Furthermore, when the test is administered the second time, the scores may be affected by the varying amounts that different students learned when taking the first test.

Procedures for the actual measurement of test reliability are a technical matter and would not be expected to be within the domain of the military training manager's job. For our purposes, reliability must be viewed from the standpoint of the factors which should prevail in a test situation in order to insure test reliability. Some of these have already been mentioned under the headings of standardization and objectivity of test item scoring. The following reviews these along with other guidelines for test reliability.

The Test and its Administration

(1) **Instructions to the students** should be as simple, clear, and complete as possible without providing answers to the test item.

(2) **The tester** should be trained in how to treat students, what student questions can be answered, how the test supplies should be maintained, and what to do in emergencies. He should maintain a noncommital attitude at all times.

(3) **Test supplies and equipment** should be available in adequate supply and, if used repeatedly, should be maintained so that a test problem becomes no easier or more difficult with use.

(4) **Environmental conditions** should be sufficiently invariable to avoid affecting student performance.

The Student

The student himself may be a source of unreliability. Illness, fatigue, the stress of the test, lack of motivation, all may contribute to his making a poor score when he really has mastered the objectives. The student should be rested, and his treatment during the test should be designed to prevent him from becoming excessively afraid of failure.

Scoring

Objectivity in scoring is achieved by setting precise standards and training the scorer to apply these standards. The standards should be in such terms as: "did" or "did

not d[illegible] a p[illegible]cular thing, presence or absence of essential attributes of a product, or measurable numbers.

Test Length

Provided all the other factors influencing reliability have been controlled as well as possible, and also provided that additional items are related to the same objectives as previously prepared items, the reliability of a test can be improved by making it longer. If several items related to the same objective are included, the effect of such factors as the wording of the instructions, or the scoring of particular items is cancelled, and the overall score will be more reliable. However, if testing time is limited, and there is a choice between adding more items to cover the same objectives, or covering more objectives with new items, the latter course is generally preferable.

The Design of Motivation and Behavior Control Techniques

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All organizations are involved in the problem of motivating their personnel to effectively apply their special skills in order to achieve the organizations' objectives. In general, the term "motivation" refers to behavior which is instigated by needs within the individual and which is directed toward goals that can satisfy those needs. Three general stages of motivation may be distinguished in most situations and this can be called the motivational cycle:

(1) The need stage which refers to some lack or deficit within the individual.

(2) Instrumental behavior or the behavior which is instrumental in satisfying a particular need.

(3) The goal or incentive toward which the instrumental behavior is directed.

The problem of motivation, which is always complicated, is especially difficult with the usual Army trainee population. This population consists of the widest possible variety of individuals, ranging from the near genius to the extremely slow, from the "gung-ho" volunteer to the most reluctant draftee, from the easy-to-get-along-with to the so-called behavior problem, plus many others. We can do many things in designing a training program which will result in causing *some* of this total population to put forth their best effort—at least *some* of the time.

Identification of Needs

What sort of needs do these individuals have? If we know these needs, we can make our training system much more effective by making satisfaction of the needs contingent upon the students learning a certain amount of our program.

Maslow (1) has characterized the hierarchical nature of needs. Before listing the needs in the Maslow hierarchy, let me point out several features to keep in mind. One is that these needs are believed to be universal; Maslow refers to them as "instinctoid" by which he means that many of them, especially the higher ones, are not strong enough to be apparent unless conditions are favorable for their manifestation. Under certain conditions, however, they *will* appear. Another point is that a lower need may be sufficiently satiated at some time so that it will no longer be a major or dominant factor in the individual's behavior, except under very unusual conditions. Satiation of a lower need is seen as a condition on which the appearance of a higher one depends.

Physiological Needs. The most basic needs are the physiological needs, like hunger, thirst, and so forth, which are based on some tissue deficit in the body. Maslow emphasizes that if one examines such needs in great detail there are more than we generally think of, especially when we consider cases of specific hungers. These needs are the most prepotent ones and, if unsatisfied, can dominate the life of the individual. This is true in hunger, thirst, or the need for air. However, in our society such needs are seldom dominant, at least in the majority of the population. Few people are really hungry or fear starvation, for example. But during times of disaster, as in the Great Depression of the 1930s, people were hungry, and starvation or the fear of it, made hunger dominate conduct.

Safety Needs. These are seen mainly in children and are said to underlie both the infant's reactions to strangers, sudden noises, the threat of being dropped, and so forth,

and the older child's desire for routine. Various security measures which adults take, such as tenured positions, savings, and all sorts of insurance, are seen as means of providing safety from the things which would upset security. Except in neurotic behavior, however, adults are not dominated by the safety needs, and they are seen in action mainly in emergencies, such as war, disease, natural catastrophes, and crime waves. It is apparent that these needs are dominant in the operational situation in Viet Nam and in some hazardous training such as firing 90mm RR. For the most part, it is impossible to really add stress to training. The Army and general public will not allow it. It is possible, however, to make training more realistic and physically demanding than it is at present.

Belongingness and Love Needs. These arise when the physiological and safety needs are relatively quiescent. The person feels keenly the absence of friends, or a sweetheart, or a wife, or children. He will hunger for affectionate relations with people in general, and he will strive with great intensity to achieve this goal. He wants to attain a place in his group more than anything else in the world and may even forget that once, when he was hungry, he sneered at love as unreal or unnecessary or unimportant. These needs are certainly applicable to our trainee population and are related to esprit, pride in outfit, being accepted by platoon, and so forth.

Esteem Needs. These represent a need for a stable, firmly based, high evaluation of themselves and a need for self-respect, as well as for the esteem of others. One set of esteem needs involves "the desire for strength, for achievement, for adequacy, for mastery and competence, for confidence in the face of the world, and for independence and freedom." A second set involves a desire for prestige, status, dominance, importance, or appreciation. With the gratification of these needs comes a feeling of self-confidence and the knowledge of worth, strength, and capability. Recognition of noncoms and buddies is extremely important. The Army, in general, places great stress on esteem. Witness Airborne, Green Berets. (Maslow, 1, pp. 90-91)

The hierarchy as we have described it is not absolutely fixed. However, to discuss variations from the pattern indicated would require a more detailed presentation than space permits. Also, it is not necessary or, in some cases, even possible that a lower need be permanently or finally gratified. It is probably more accurate to say that the need is *largely* satisfied or that there is a history of extensive gratification of the need; under these conditions, higher needs may appear. It must also be pointed out that gratification of a need is satisfactorily achieved only when "intrinsically appropriate satisfiers" are involved. "For the love-hungry, there is only one genuine, long-run satisfier, that is, honest and satisfying affection. For the sex-starved, food-starved, or water-starved person, only sex, food, or water will ultimately serve." (Maslow, 1, p. 110)

Failure to satisfy the basic needs leads to deficiency conditions, analogous to a vitamin deficiency. It can be argued that gratification of these needs is essential to psychological health. These needs are basic because (a) the absence of their satisfiers prevents psychological health, (b) the presence of the satisfiers prevents illness, (c) restoration of the satisfiers overcomes the illness, (d) the satisfier is chosen by the deprived person over other satisfactions, and (e) in healthy people such needs are absent.

Identification of Reinforcers

In general, reinforcers are used to increase the probability that students will learn and maintain specified skills or knowledges.

There are two general types of events which are found to be reinforcing. Some reinforcements consist of *presenting* stimuli, of adding something—for example, food, water, or sexual contact—to the situation. These we call positive reinforcers. Others consist of *removing* something—for example, a loud noise, a very bright light, extreme cold or heat, or electric shock—from the situation. These we call *negative* reinforcers. In

both cases the effect of reinforcement is the same—the probability of response is increased.

In every field in which human behavior figures prominently—education, government, the family, the clinic, industry, art, literature—we are constantly changing probabilities of response by arranging reinforcing consequences. The industrialist wants employees to work consistently and without absenteeism. He therefore must make certain that their behavior is suitably reinforced, not only with wages but with suitable working conditions. The girl who wants another date must be sure that her friend is suitably reinforced. To teach a child to read or sing, we must work out a program of educational reinforcement in which appropriate responses "pay off" frequently.

We can determine the strength of reinforcing events in various ways. One way is to discover what someone is "getting out of life." A person's everyday behavior can tell us a great deal about reinforcers. We infer important reinforcers from nothing more unusual than his "interest" in certain subjects, in stores or museums which exhibit certain objects, in friends who exhibit certain kinds of behavior, in restaurants which serve certain kinds of food, and so on. The "interest" refers to the probability which results from the consequences of the behavior of "taking an interest."

We can make sure of the importance of a reinforcer if we watch the effect on his behavior as the reinforcer is alternately supplied and withheld. The behavior of associating with a particular friend varies as the friend varies in supplying reinforcement. If we observe this covariation, we may then be fairly sure of "what this friendship means" or "what our subject sees in his friend." This technique of evaluation may be improved in clinical and laboratory investigation where outside variables can be controlled.

We cannot dispense with this survey simply by asking a man what reinforces him. His reply may be of some value, but it is by no means necessarily reliable. In many instances, a person simply tells us what he thinks we want to hear. A reinforcing connection need not be obvious to the individual reinforced. It is often only in retrospect that one's tendencies to behave in particular ways are seen to be the result of certain consequences, and the relation may never be seen at all even though it is obvious to others. There are, of course, extensive differences between individuals in the events which prove to be reinforcing.

Schedule of Reward

The scheduling of reinforcement is crucial in developing and sustaining individual behavior leading toward learning. In general, reinforcement can be continuous or partial. Continuous reinforcement involves reinforcing a response every time it occurs. Partial reinforcement takes the form of providing reinforcement on some trials but not on others. For example, if an experimenter is examining the influence of partial reinforcement on a rat's running a straight-away, it is a simple matter to determine on what trials the animal shall (as well as shall not) receive reinforcement.

Example 1: Paper boy selling papers.
- a. One person always buys (continuous).
- b. One person buys by chance (partial).
- c. Both stop.
  - (1) Continuous—boy gets angry at.
  - (2) Partial—boy continues to try to sell for months.

Example 2: Son drawing stick figures.
- a. Continuous—always draws stick figures.
- b. Partial—improves.

This is the more crucial reinforcement provided in practical learning situations.

Four types of partial reinforcement are:

(1) **Fixed interval.** Here, reinforcement follows the first response which the organism makes after some fixed period of time as measured from the last reinforcement. With a 30-second fixed interval schedule, for example, reinforcement is provided for the first response which occurs 30 seconds or more following receipt of previous reinforcement.

(2) **Variable interval.** With this schedule, reinforcement is provided after a variable, rather than a fixed, period of time which separates one reinforcement from the next. Thus, a 30-second variable interval schedule consists of a schedule of reinforcement administered for the first response which follows randomly selected time intervals which average 30 seconds.

(3) **Fixed ratio.** Here, reinforcement is provided after every _n_th response. For example, a 20:1 fixed ratio schedule means that every twentieth response is followed by reinforcement.

(4) **Variable ratio.** With this schedule, the number of responses which must be made in order to secure reinforcement varies, but the varying numbers of responses are averaged to provide a descriptive statement of the kind of schedule employed. Thus, a 10:1 variable ratio schedule would be produced by the following: 4 responses (reinforcement); 14 responses (reinforcement); 10 responses (reinforcement); 6 responses (reinforcement); and 16 responses (reinforcement).

Types of Reward

Knowledge of results. This is a factor commonly thought to have motivational aspects, since information is provided by the knowledge. The term refers to procedures by which the subject is informed of the quality or quantity of his performance. An early experiment by Johanson (2) is illustrative. He measured the speed with which a subject pressed a telegraph key on signal. Under one condition, subjects received no information about the speed of their reactions; in another they were told the speed of their reaction before the next trial. On the average, the latter group performed more quickly than the former group. Ammons (3) has reviewed the literature of this problem and concludes that knowledge of results, typically, achieves better performance than no knowledge of results, and that at least some of this effect may be attributed to the interest, attention, and avoidance of boredom which knowledge of results can provide. It is clear, however, that information, as well as motivation, is yielded by knowledge of results, and it is not certain how much of the advantage is due to the motivation or to the information provided by the knowledge of results (McFann, 4).

Knowledge of results, of course, provides a standard by which a subject can judge his performance against his past efforts or against some standard which has been provided for him by the experimenter. The procedures known as praise and reproof (or blame) and encouragement and discouragement typically have involved a general evaluation by the experimenter of the overall performance of a group or of individuals as good or bad or as satisfactory or unsatisfactory. There is, thus, some knowledge of results in these procedures, although it is rather unspecific, and the evaluation of his work cannot be or is not usually made by the subject himself. The text by Smith (5) covers knowledge of results quite thoroughly.

Level of aspiration. Most studies of incentives are rather gross; that is, they involve the performances of groups after different treatments. Little can be discovered in this way about how the individual sets his goal and reacts to his own performance or to evaluations of that performance by others. A technique which has had much use in the study of the factors involved in level of aspiration was developed by Kurt Lewin and his students (6). In this procedure the subject is asked to state what his performance will be

on some task on the next trial of the task. A simple illustration will indicate the procedure. Suppose a subject is asked to carry out a series of trials in throwing darts at a target. He may be asked to say, before any trials, how well he expects to perform in terms of markings on the target on the first trial. After completing the trial and seeing how well he performed, the subject is asked to state how well he expects to do on the next trial. Again he throws, sees the result, and indicates how he will do on the third trial, and so on. It is possible, perhaps, to alter his feelings of success and failure by ascribing certain levels of performance to groups with which he can compare himself; for example, athletes or nursery-school children. In certain tasks in which the subject cannot actually see how well or poorly his effort turns out, the experimenter can report on the performance, indicating success or failure (regardless of actual outcome) according to experimental requirements.

These procedures are not without difficulties. A serious problem is that the subject's prediction will vary as he is asked to state it in different ways. It was found that the discrepancy between the subject's last performance and his aspiration level was about twice as great, when he was asked to state what he "hoped" to do on the next trial, as it was when he was asked what he "expected" to score on the next trial. It is clear that many subjects hope to do better than they expect, realistically, to do. The variability of actual performance on the task is important, too. Where there is little variability, the subject's goal can be realistically governed by knowledge of his probable performance; this is not the case when his performance varies widely from trial to trial.

A quite widely accepted generalization from experiments on level of aspiration is that successful performance leads to an increased level of aspiration and that unsuccessful performance (failure) leads to a reduced level of aspiration. Knowledge (whether true or false) of what other groups have achieved or of what members of one's own group have achieved also affects goal-setting.

Social factors. A great deal of work has been done in exploring the influence of social factors on human performance. Included in these studies have been the influence on behavior by such factors as audiences, partners, rivalry, cooperation, and competition. The initial studies of social factors in relation to behavior were carried out in the context of a controversy over the concept of group mind. This controversy concerned the issue of whether, in a group, there is or is not a factor or a process which transcends the particular individuals involved. An alternative to the group mind was to argue that the group's properties contain nothing not already present in the individual members of the group. The most influential investigations were done by F.H. Allport (7, 8). His research involved an experimental comparison of behavior when the individual worked alone and when he worked in the company of others who were also carrying out the same tasks. An effort was made to minimize rivalry and competition among individuals in the latter situation, and there was no overt interaction among them. The effort was to create a situation of just being in the presence of others as opposed to being along. Subjects were engaged in such tasks as free chain associations, letter cancellation, reversible perspective, multiplication, reasoning tasks, and judgments of odors and weights. Allport found evidence of social facilitation in that at least some subjects on some tasks showed a quantitative increase in output under social conditions. He also found some disruptive effects, arising from distraction and excitement. Qualitatively, the reasoning products developed in the social situation were often not as good as those from the alone condition. Extremity of judgment was reduced in the social as compared with the individual situation.

A number of experiments have been done on the effects of rivalry or competition. In general, the results indicate that putting children or college students in a competitive situation with others increases the quantity or speed but not necessarily the quality of their work. There are individual differences, too, some subjects responding well

and others poorly to the competitive situation. It was also determined that competition between two paired individuals was more productive of increased performance than was putting two groups of subject against each other; in the latter the individual's score became a part of the score of his group.

A final type of social influence was that of prestige suggestion—group, majority, or expert opinion. Various reactions, opinions, and judgments of subjects were shown, on the whole, to be susceptible of change in the direction of group, majority, or expert opinion. The influence of an expert, or respected individual, had a profound influence in changing individual attitudes.

Example: Eisenhower vs. Mao Tse-tung.

Conformity. When one is a member of a group, there are a number of reasons why he will tend to change his way of acting, thinking, believing, or feeling in the direction of the norms of the group. The pressures of others are brought to bear on the individual, and frequency of interaction is a factor. As a group member, one must forego some of one's individuality if the group is to maintain itself and to provide at least some satisfaction for its members. The fact of increased uniformity as a result of group membership is well established in many instances. However, mechanisms of the development of uniformity are often unspecified or little understood.

A situation developed by Asch (9, 10) has received a good deal of attention in relation to group influences on judgment. Asch constituted groups of subjects for the purpose of making perceptual judgments (e.g., to match the length of one line with one of three other lines). In some of the experiments, groups with as many as eight subjects were employed, all but one of them accomplices of the experimenter. (Example: Nichols, *et al.*, 11) The lone "real" subject, then, could be subjected to the influence of majorities of various sizes. Typically, the procedure was to ask each subject to announce his judgment publicly. The accomplices would make erroneous judgments, and the object of the experiment was to observe what the critical subject would do in the conflict between the evidence of his senses and the pressure to conform to what the rest of the group apparently saw. A number of subjects in this situation "yielded" to the majority and shifted their judgments from accurate ones to inaccurate-but-group-sanctioned ones. Others continued to give veridical judgments, being able, apparently, to maintain their "independence" despite the pressure of the majority.

Military incentive. The military situation provides an opportunity to use a wide variety of reinforcers—in many instances more than are available to a civilian program. This results from the fact that it is possible to exert such tight control over the life and activities of the individual trainee. Specific reinforcers in the military would include:

(1) Rest periods and breaks.
(2) Incentive passes.
(3) Knowledge of results.
(4) Priority in mess hall.
(5) Freedom from disagreeable details.
(6) Individual achievement honors.
(7) "Release" from the military situation for varying periods.
(8) Competitive practice.
(9) Contrast between "boring" and "interesting" presentation.
(10) Recognition of individual or group achievement.
(11) Monetary rewards.
(12) Early promotion.
(13) Choice of assignment.
(14) Choice of reinforcement--Reinforcement menu; give trainees a choice of reinforcement.

Bialek and McNeil (12) List:

(15) Important decision.
(16) Recognition.
(17) Free time.
(18) Cash or goods.
(19) Getting out of onerous tasks.
(20) Greater comfort.
(21) Greater variety and/or responsibility.

New Developments in Behavioral Control

Shaping

The proper use of reinforcement techniques leads to "shaping" an individual's responses until the desired behavior is achieved. We can illustrate this by taking an example of teaching a pigeon to peck a spot on a wall. To get the pigeon to peck the spot as quickly as possible, we proceed as follows: First, present the pigeon with bird food when it turns slightly in the direction of the spot from any part of the cage. This increases the frequency of such behavior. Then withhold reinforcement until a slight movement is made toward the spot. This again alters the general distribution of behavior without producing a new unit. Continue by reinforcing positions successively closer to the spot, then by reinforcing only when the head is moved slightly forward, and finally only when the beak actually makes contact with the spot. We may reach this final response in a remarkably short time. A hungry bird, well adapted to the situation and to the food tray, can usually be brought to respond in this way in two or three minutes.

The original probability of the response in its final form is very low; in some cases it may even be zero. In this way, we can build complicated operations which would never appear in the repertoire of the organism otherwise. By reinforcing a series of successive approximations, we bring a rare response to a very high probability in a short time. This is an effective procedure because it recognizes and utilizes the continuous nature of a complex act. The total act of turning toward the spot from any point of the box, walking toward it, raising the head, and striking the spot may seem to be a functionally coherent unit of behavior; but it is constructed by a continual process of differential reinforcement from undifferentiated behavior. When we wait for a single complete instance, we reinforce a similar sequence but far less effectively because the earlier steps are not optimally strengthened.

Through the reinforcement of slightly exceptional instances of his behavior, a child learns to raise himself, to stand, to walk, to grasp objects, and to move them about. Later on, through the same process, he learns to talk, to sing, to dance, to play games—in short, to exhibit the enormous repertoire of responses characteristic of the normal adult.

Contingency Management

A recent definition of reinforcement has been proposed by Premack who has hypothesized that "reinforcement results when an R (response) of a lower independent rate coincides, within temporal limits, with the stimuli governing the occurrence of an R of a higher independent rate." This hypothesis has been tested many times in experiments by Premack (13, 14) and Homme (15, 16, 17) which we will cover in a few minutes. One interesting feature of Premack's hypothesis, however, is that it indicates that reinforcement has relative rather than absolute properties. If the independent rates of several of an organism's responses are determined in advance and can be ranked in terms of rate, all possible contingencies between the ranked responses can be investigated. Thus, if A, B, and C represent three responses with independent rates of responding in the order stated, it would follow from Premack's position that A should reinforce both B and C, B should reinforce C but not A, and C should reinforce neither A nor B.

There is a growing technology concerning the application of the laws of behavior. In the application of the laws of behavior to practical affairs, the most important factor is motivation. Although motivation is widely held to be a complex phenomenon, the practical problem of motivation is reduced to this simple question: What reinforcers are available? With control of reinforcing events, one can produce a motivated organism, that is, an organism which will respond under the circumstances specified. Without such control, only the accidental contingencies of the environment operate. While psychologists agree that a reinforcing event is necessary to increase or maintain response strength, it is only when we ask, "What is the nature of reinforcement?" that we encounter disagreement.

Types of Reinforcement. Most of the time reinforcement is explained in terms of drive reduction. In drive reduction, reinforcement is said to reduce drive stimuli, to reduce or satisfy a need. Although this explanation has been widely applied, it has not been wholly satisfactory, both for theoretical and practical considerations.

Two other explanations of reinforcement have gained attention. One of these states that reinforcement is a change in stimulation; the other maintains that reinforcement is the opportunity to emit a high probability response. In operant responding, some behavior leads to a reinforcing event. It has generally been overlooked that this event consists of two independently observable occurrences, the introduction of a food pellet and the subsequent eating of it. Traditionally, emphasis has been placed on the reinforcing stimulus, the presentation of the pellet. It may be, however, equally as important to emphasize the reinforcing response.

In an important series of papers beginning in 1959, Premack has been saying, and finding evidence in support, that there is no need to invoke a drive concept in explaining why water, as an example, functions as a reinforcer. If water functions as a reinforcer, it does so simply because the experimenter has arranged matters (by deprivation) so that drinking has a higher probability than the response to be strengthened. As further support for this formulation, he has shown that, under appropriate conditions, drinking can be reinforced by the opportunity to run. In Premack's experiments, it is the reinforcing response which is emphasized, not the reinforcing stimulus. Extending this conceptualization, it may be possible to predispose a human subject so that, momentarily at least, a given behavior is at a higher probability than one we are attempting to strengthen.

In the case of an experimental animal, the same response, eating, for example, continues to be a high probability behavior throughout the experiment. In the case of the non-experimental animal or the non-deprived human, on the contrary, behavior probabilities vary from moment to moment. What is a high probability behavior at one moment will get executed and instantly become a low probability behavior the next, and this is the important point to remember with trainees. Moreover, it may remain a low probability behavior for a long interval. For example, when the pet cat awakens, eating and whatever preceded eating on prior occasions are high probability behaviors. Once eating has occurred, its probability is near zero, and getting out of the house may now be a high probability behavior. Once out, this, of course, is a near zero probability response, and some time later getting in is a high probability behavior. Similarly, with a human, smoking may be a high probability behavior at one instant. A minute or two later, it may have a probability close to zero. "Getting a glass of water" may be an extremely high probability behavior at one instant; after drinking, it may be close to zero, and so on.

When we think of a reinforcer, we are inclined to think of something with rather stable properties. Food for a food-deprived organism, water for a water-deprived organism, evoke the same behavior from one reinforcement to the next. Premack's analysis of what the sufficient properties of a reinforcing response are, however, imposes no such constraints. If Premack's data are taken seriously, we will not ask, "What is the

reinforcer for this session?" We will ask, rather, "What is the reinforcer at this instant in time?"

The notion of a reinforcing response has led to the discovery of many "new" reinforcers. It is difficult to classify all these as being high probability behaviors because they may not be emitted more than once in any session.

Experiments in Reinforcement. In a recent experiment with nursery school children, high probability behaviors were used to reinforce lower probability behaviors. It is doubtful that a drive reduction position would lead to the notion that having the opportunity to run down the hall could be classified as a reinforcing event. Notice that in the case of their reinforcing event there is no clearly identifiable reinforcing stimulus, unless it is the verbal instruction, "Run down the hall." Nevertheless, when the behavior of running down the hall was made contingent upon the emission of counting, it was possible to shape counting behavior. This example illustrates the advantage of speaking of a reinforcing event, a concept which includes both the reinforcing response and the discriminative stimulus which sets it off.

Lloyd E. Homme (16) indicates that in the practical application of the Premack principle, one usually doesn't have the time or facilities to define behavior probabilities in terms of relative frequency of occurrence. Thus, the term *probability* is used in the everyday, nonrigorous sense. Children will often announce, without urging, what their high probability behaviors are at the moment. For example, when a child says, "Let's go for a walk," or "Let's play this game," or when he points to a drawing of a particular event on a menu of reinforcing events (Addison and Homme, 18), he is informing the contingency manager of what will reinforce at that particular moment. To strengthen a low probability behavior, the contingency manager simply calls for an approximation of it, and then permits a short time for interacting with the reinforcing event.

In practice, the contingency manager specifies a series of micro-contracts which substantively take the form: "Execute some *amount* of low probability behavior; then you may immediately engage in some high probability behavior for a specified *time.*"

The differential probability hypothesis is notable not only for what it says, but for what it does not say. It does not say: "Of any two responses, the more probable one will reinforce the less probable one in middle-class or upper-class children"; ". . . in white children"; ". . . in emotionally nondisturbed children"; or ". . . as long as the *S* has not come from a different culture." What is being said is that, as long as the *S* is an organism, the differential probability rule will hold. Happily, as the following examples are intended to illustrate, we seem to be finding this to be the case.

The initial attempt in using the Premack principle proved remarkably effective with three exuberant three-year-olds (Homme, *et al.*, 16). The high probability behaviors used as reinforcers were of the sort generally suppressed by the environment, such as running and screaming. The contracts specified by the contingency manager were of the sort, "Sit quietly and watch what I do at the blackboard; then you may run and scream until the timer goes 'Ding.'" Although, as it should, the technology employed in this initial attempt now looks crude, there can be little doubt that it was effective.

There are any number of authorities to explain how and why children of the poor are different. To find out if they obeyed a different set of behavioral laws, staff members of this department sought out two Negro boys, five and six, of poor families. It may be argued that these were not "real" slum kids, since our town does not have slums, but they were at least poor.

What was most striking to us in this pilot project was the speed with which these children from a different culture learned middle-class behaviors. They learned instantly, for example, to knock on a door and inquire, "May I come in?" when entering the reinforcing event area was contingent on this behavior. They cheerfully fulfilled small contracts of the usual sort: "Execute some low probability behavior (find another letter

that looks like this one), and then you can execute some high probability behavior." We were prepared to find that different high probability behaviors would have to be used to reinforce these children, but this was not the case. The usual program of water colors, crayons (after they were shown how to use them), pushing a castor-equipped chair, and so forth, served to reinforce behaviors very nicely.

Guidance counselors were used to recruit 23 adolescents for a study (Homme, 17) of adolescents who were high school dropouts or judged to be potential dropouts. These adolescents had the behaviors usually associated with "street kids." They spoke a hip jargon, some of them were discovered to be carrying knives, some of them wore their sun glasses at all times, and so on. The low probability behavior for these subjects was getting themselves through programed instructional material in subjects like arithmetic and reading. Most of the high probability behaviors used to reinforce these were of the conventional sort: time for a break, coffee, smoke, coke, and so on. However, there were some surprises. For some of these subjects going through a program in Russian proved to be a reliable high probability behavior. When this was discovered, their contracts would take a form like the following: "Do 20 frames of arithmetic; then you can work on Russian for 10 minutes." This does serve to illustrate that one need not know why a high probability behavior exists in order to use it as a reinforcer.

The success of the project was mainly in terms of the excellent motivation exhibited by these subjects. After the first week, there were no dropouts, and attendance was virtually perfect. Absences which did occur were all accounted for, and 100% of them were made up by working extra time. And there were no fights. A generally pleasant emotional atmosphere prevailed, in spite of the fact that these adolescents were of the "hard-to-handle" variety prior to the project.

Five-year-old nontalking Diana (IQ about 43) was about the size of a normal three-year-old. When she was first brought to the laboratory, she had a vocabulary of half a dozen words. Among them was the phrase, "What's that?" This phrase served quite reliably to get action from adults, particularly strangers. Unsuspecting staff secretaries, for example, were often heard giving quite complete, technical descriptions of their electric typewriters. The fact that Diana had comprehended nothing of the explanation, of course, did not stop her from repeating the question while pointing her finger in another direction.

Basically, the same contingency management system which worked with bright three-year-olds was quite satisfactory to Diana. The differences were that she was taught to use the menu by getting her to point at some object, and having the object immediately appear. For example, if she pointed to a piece of candy, a piece of candy was immediately given to her; if she pointed at a ball, a ball was immediately rolled to her, and so on. Those familiar with laboratory procedures (Homme and Klaus, 15) will recognize this as an instance of magazine training.

The low probability behavior we set out to strengthen was imitation of speech. Starting out with the requirement that one should be approximated before a reinforcing event occurred, the requirement was gradually shifted upwards until the imitation of ten or so words could be demanded before a minute of reinforcing activity was permitted. With this kind of management, her vocabulary increased to around 200 words. But our chief interest in this project was not to see how much behavior we could instill; it was rather to see whether contingency management would be effective in the case of a defective organism. It was.

On first coming into contact with contingency management and the Premack principle, students of behavior usually ask, "How do you find high probability behaviors?" The answer is, "Let the *S* tell you." The more experience we get in this area, the more we are inclined to think that *S* will always do this. He may not do it verbally, but he will find a way. The following contingency management interaction is illustrative.

When the contingency manager first saw the subject, a 16-year-old blind inmate, she was sitting quietly in a ward of a state mental hospital. Her chair was against the wall, and she was staring straight ahead through sightless eyes just as she had been doing most of her waking hours for the eight years she had been hospitalized. What were her high probability behaviors? There appeared to be none. But when the contingency manager walked over to her and spoke, she indicated what at least one of them was. She seized his hand and smelled the back of it. To condition verbal behavior, the contingency manager simply withheld his hand until some approximation to an acceptable response to the command, "Say X," was executed (where X was some word or phrase). Immediately after the patient verbalized, the contingency manager would give her his hand to smell for a few seconds.

With this kind of management, within an hour the contingency manager had reinforced sufficiently so that the verbal rate had increased considerably. The hospital's clinical psychologist intern remarked that the patient had never talked so much at one time since he had known her.

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13. ABSTRACT

A 96-hour course on the management of training was developed and evaluated for presentation to Advanced Officer classes. The general procedures followed in developing the course were: construction based on job task statements, a systems engineering approach to training, and state-of-the-art technology; repeated presentation of course materials, and modification by training research personnel on the basis of student and instructor appraisals. The course was then presented and evaluated by a military instructor. Critiques by military students and staff indicated that the course had considerable value but required some additional revision before adoption by the Army. Suggested revisions were: (a) reducing course length, (b) integrating the course and CONARC Regulation 350-100-1, (c) coordinating supporting literature and course objectives, and (d) implementing the revised course as a common subject in Officer training programs. These revisions would not require further research and development and could be accomplished by military operational training personnel with technical advice by research personnel.

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